THE

Practical Teacher

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Honours Hygiene.

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DIETETICS.

THE subject of exercise naturally leads to the consideration of the food taken, as the energy exerted is dependent on the oxidation of food in the tissues. Muscular tissues are chiefly composed of proteid material, but it has been conclusively shown that the elimination of urea (the ultimate stage reached by proteids before excretion) is little, if at all, increased by exercise. It is evident therefore that the energy of the body is obtained chiefly by the oxidation of hydrocarbons (fats) and amyloids (starch and sugar).

Inasmuch as the wasting of muscular tissue is not appreciably increased by exercise, it follows that persons engaged in active exercise do not on that account require an extra amount of proteid food. They require no more than when they are at rest, though they may require somewhat more than those people who have permanently sedentary habits, because they have larger muscles and larger frames generally than the latter. The amount of fatty and amyloid food must, however, be increased when exercise is taken, and in proportion to the amount of exercise. A certain amount of oxidisable food is required for the internal mechanical work of the body (estimated by Parkes at 260 foot-tons). An ordinary day's work for an adult is reckoned at another 300 foot-tons; and a laborious day's work at 450 to 500 foot-tons. In nearly all the text-books dietaries are given for each of these conditions, the amount of proteid material being given as an increased amount in proportion to the increased work done. This is, however, founded on Liebig's erroneous conception that muscle is consumed in action.

Moleschott gives the following as a standard diet:—4·587 ounces avoir. of albuminoid or proteid material, 2·964 ounces of fatty material, 14·250 ounces of carbohydrates, and 1·058 ounces of salts; making a total of 22·859 ounces of dry food. Inasmuch as ordinary food contains from 50 to 60 per cent. of water, the total solid food is 46 ounces. To this must be added from 50 to 80 ounces of water taken as such in beverages.

According to Parkes 1 oz. of water-free proteid material contains 69 grains of nitrogen and 233 of carbon; 1 oz. of water-free fat material contains 0 grains of nitrogen and 345·6 of carbon; 1 oz. of water-free carbohydrate material contains 0 grains of nitrogen and 194·2 of carbon.

Moleschott's diet, therefore, contains 316·5 grains of nitrogen and 4860·5 grains of carbon.

From the table given at page 48 of Newsholme's *Hygiene*, and from the following table of per centage amount of food stuffs in different foods, dietaries can be easily-calculated.

	In 100 Parts.				
	Water.	Albuminates or Proteids.	Fats.	Carbo-hydrates.	Salts.
Uncooked meat with little fat	74·4	20·5	3·5	—	1·6
Cooked meat—without loss	54	27·6	15·45	—	2·95
Salt beef	49·1	29·6	0·2	—	21·0
White fish ...	78·0	18·1	2·9	—	1·0
Bread, white wheaten	40·	8·	1·5	49·2	1·3
Wheat flour ...	15·	11·	2·	70·3	1·7
Rice	10	5	·8	83·2	0·5
Oatmeal	15	12·6	5·6	63·0	3·
Peas (dry) ...	15	22·	2·	53·	2·4
Potatoes	74	1·5	·1	23·4	1·
Butter	8	2·	88	—	variable
Egg (including shell, for which deduct 10 p.c.)	73·5	13·5	11·6	—	1
Cheese	36·8	33·5	24·3	—	5·4
Milk	87·0	4·	3·5	4·8	·7

Example 30.—How much bread and cooked meat would be required to provide sufficient carbon and nitrogen *per diem* for a man engaged in moderate work?

The amount of nitrogen required may be taken as 300 grains.

BRITISH MUSEUM

The amount of carbon required may be taken as 4,800 grains.

Now bread contains 5·5 grains of N and 119 of C per ounce.

Cooked meat contains 19 grains of N and 117·7 of C per ounce. (*Hygiene*, page 48).

Let x = number of ounces of bread required,
and y = " " meat "

Then $5{\cdot}5x + 19y = 300$

Also $119x + 117{\cdot}7y = 4800$.

By working out this double equation, it will be found that $y = 5{\cdot}7$ ounces (of meat),
and $x = 34{\cdot}85$ ounces (of bread).

Example 31.—How much oatmeal, milk, and butter, of the following percentage composition, would be required to give a sufficient quantity of albuminoids, fats, and carbohydrates to an adult male?

	Albuminoids.	Fats.	Carbo-hydrates.
Oatmeal ...	12	6	60
Milk ...	4	3	5
Butter ...	2	88	—

Let x = number of ounces of oatmeal required.
y = " " milk "
z = " " butter "

Then $\frac{12x + 4y + 2z}{100} = 4{\cdot}5$ ozs. of albuminoid

$\frac{6x + 3y + 88z}{100} = 3$ ozs. fat

$\frac{60x + 5y}{100} = 14{\cdot}25$ ozs. carbohydrate,

according to Moleschott's diet.

When these equations are worked out by substitution and transference

$x = 19{\cdot}2$ ounces.
$y = 55{\cdot}4$ "
$z = 0{\cdot}24$ "

Example 32.—How much meat, bread, and butter of the following per centage composition will be required to give a man a sufficient amount of albuminoids, fats, and carbohydrates?

	Albuminoids.	Fats.	Carbo-hydrates.
Meat ...	25	15	0
Bread ...	8	1·5	50
Butter ...	2	88·	0

Let x = number of ounces of meat required.
y = " " bread "
z = " " butter "

Then $\frac{12x + 8y + 2z}{100} = 4{\cdot}5$ ozs. albuminoid

$\frac{15x + 1{\cdot}5y + 88z}{100} = 3$ ozs. fat

$\frac{50y}{100} = 14{\cdot}25$ ozs. carbohydrates.

When these equations are worked out

$x = 6{\cdot}28$ ounces.
$y = 28{\cdot}5$ "
$z = 1{\cdot}15$ "

ENERGY OBTAINABLE FROM FOOD.

Drs. Frankland and Playfair, assuming that the analogy of Joule's law held good as regards the energy obtainable from food, calculated the amount of potential energy contained in various food stuffs. Joule discovered by exact experiment that the mechanical power obtained from a given amount of fuel is directly proportional to the amount of fuel used, being in fact due to the oxidation of this fuel, the heat produced being transformed into mechanical power. Calculating on the same basis, Frankland estimated that—

1 oz. dry albumin	yields	174	foot-tons of potential energy.
" fat	"	378	" "
" starch	"	135	" "
" cane sugar	"	129	" "
" glucose or lactose	"	122	" "

Playfair calculated that 1 oz. of dry albumin would by oxidation produce enough heat to raise 125 kilogrammes of water 1°C, or to lift 173 tons one foot high, which corresponds closely to Frankland's result.

It must be remembered, however, that metabolism within the body is by no means identical with oxidation outside it; and that albumin and other allied bodies do not become completely oxidised within the body, but leave it in the form of urea, which is a comparatively complex body. Further, the ease with which a body is digested and assimilated in the body by no means corresponds with the ease with which the same body would undergo oxidation.

The above estimates of potential energy must therefore be taken as only theoretically correct. It would appear from these estimates that fat is nearly three times as valuable as the same weight of starch; but in all probability it is not more than one and a half times as valuable. Inasmuch, however, as examination questions are still given on the basis of the theoretical data supplied by Frankland and Playfair, I append the following example:—

Example 33.—A man does work equal to 176·8 foot-tons in a day. Supposing that he eats only bread, how much will he require to develop the amount of force required?

Now bread contains 8 per cent. proteid, 1·5 per cent. fat, and 49·2 per cent. carbohydrate.

Therefore from 100 ounces of bread the amount of potential energy obtainable is as follows:—

$8 \times 174 = 1392$ foot-tons
$1{\cdot}5 \times 378 = 567$ "
$49{\cdot}2 \times 130 = 6396$ "
Total energy = 8355 " obtained from 100 ozs. bread.

Let x = number of ounces of bread required to develop 176·8 foot-tons of energy.

Then $8355 : 100 :: 176{\cdot}8 : x$.

Therefore $x = 2{\cdot}1$ ounces.

(To be continued.)

Practical Kindergarten Lessons for English Elementary Schools.

BY MRS. MORTIMER.

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XVII.

GIFT XVIII.

EXAMPLES OF LESSONS.—MATERIAL FOR PAPER FOLDING.

This is one of the most important Gifts, for by its means, the children learn Form and Colour, and gain very much general knowledge. Besides this, it gives them great manual dexterity, and thus prepares the way for various occupations in after life.

The children, after a few exercises in folding the sheet of paper, will produce a great variety of instructive and interesting forms.

But the teacher must be careful to introduce the forms gradually and to accompany the work with pleasant, interesting, and instructive conversation. While the children are thus learning to fold, they are being taught to speak well and accurately, and are also gaining much useful information. The teacher must bear in mind that strictest care and cleanliness form an essential part of this occupation.

Oblong strips of paper should first be used for folding, and afterwards, squares.

The oblongs should be two and a half inches wide and seven inches long. A half sheet of letter paper will cut into four oblongs.

An oblong should be passed to each child. The children should then be required to say all they can about it. It is paper, white, thin, smooth; it can be folded, and it can be easily torn.

The teacher might here introduce a short simple lesson on paper, of what it is made, and some of its uses, etc.

They will also learn that it has four corners and four edges—that two of the edges are long and equal, and two are short and equal—that it has four right angles—therefore it is an oblong.

They must then be exercised in pointing quickly and accurately to the lines and corners, thus—the top right corner, the bottom left corner, the top left corner, and the bottom right corner.

The top and bottom horizontal lines and the right and left perpendicular lines (Plate XL., oblongs).

They must now begin to fold, thus:—Take the bottom horizontal edge (long lines to be horizontal) in your two hands and fold it over to the top horizontal edge—when the edges are exactly level, press the paper down very firmly; the children will see that they have another oblong, one half the size of the first. The paper should then be opened or unfolded to show that it is divided by a horizontal line into two oblongs. There are now three horizontal and two perpendicular lines. They should now fold the right perpendicular line to the left, taking care that the right edge is exactly on top of the left, before the paper is pressed down in the middle. The children now have another oblong, but this time it is a short one. On the paper being opened, they will see a new perpendicular line crossing the central horizontal one; these two lines divide the paper into four oblongs. All these particulars the

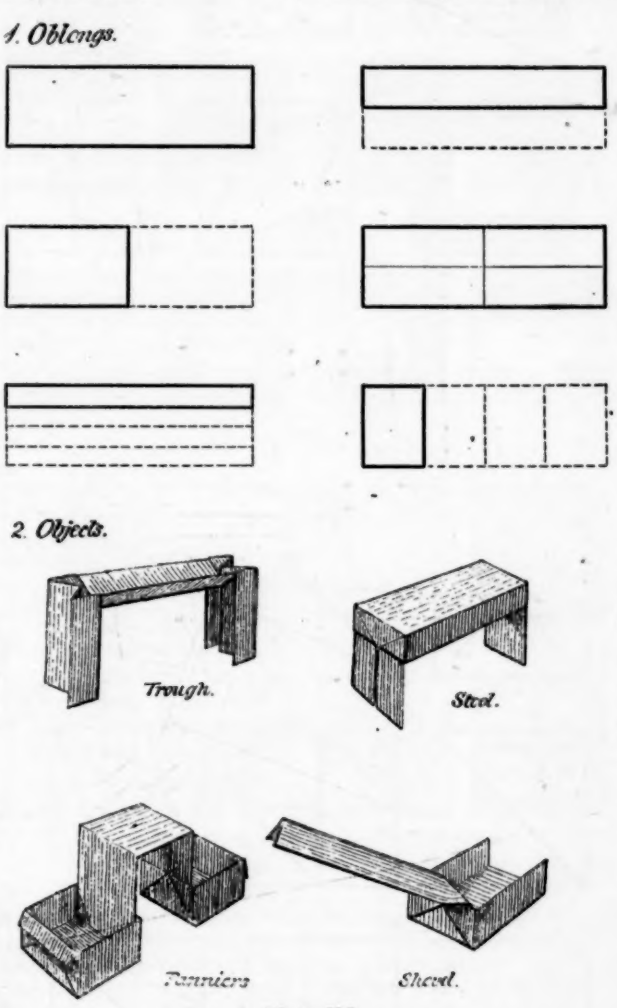

Plate XL.

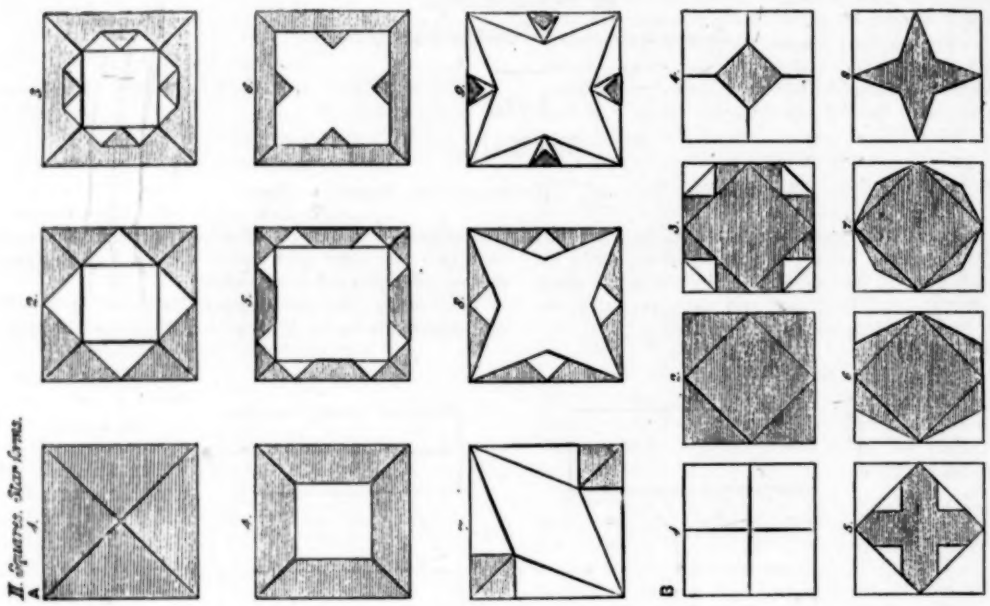

Plate XLII.

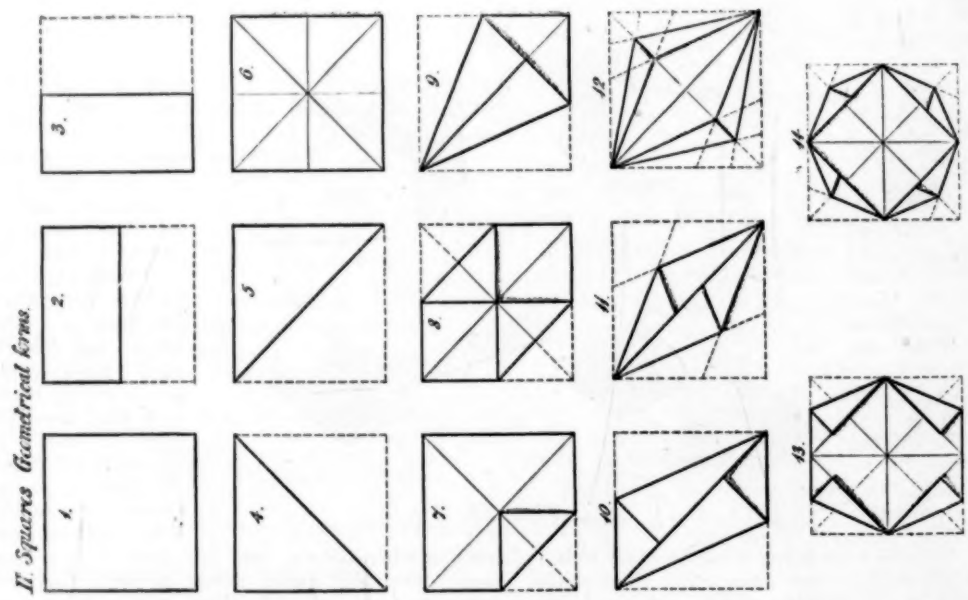

Plate XLI.

children must learn before beginning to fold the objects.

The simplest object and therefore the first to be folded is the spill, then follow the shovel, form or bench, table, reading desk, hatchet, trough, bath, panniers, etc. (Plate XL., objects).

When each object is folded, the teacher and children must have some conversation about it, indeed, a short object lesson could, with advantage, easily be given on each of the folded forms.

After a while the children may have square pieces of paper to fold. These should be about four inches square. They should be folded into I. Geometrical forms, II. Objects, III. Star forms.

I. Geometrical forms

(Plate XLI.).

Squares of either white or coloured paper should be given to the children. (It is economical to use white at first, giving the coloured ones afterwards as a reward).

The children describe the paper and compare it with the oblong. This new paper is a square. What have they seen square before? What is a square, etc.? If they fold the bottom horizontal edge to the top they have an oblong. On opening the paper, they will see a middle horizontal line dividing the square into two oblongs. If they fold the right perpendicular edge to the left, they will produce another oblong the same size as the last, but perpendicular instead of horizontal. On opening this paper now, they will see a perpendicular and horizontal line crossing each other in the centre of the square and dividing the square into four small squares. They should now take the right top corner and fold it to the bottom left corner, they thus making a triangle. This should be examined; it has one right angle and two acute angles; therefore, it is a right angled triangle. On opening the paper, they will see a slanting line going from corner to corner across the square. This line divides the square into two right angled triangles. If they now make the other diagonal of the square, by folding the left top corner to the bottom right corner, they will find that they have another triangle similar to the other.

When the paper is opened they see four lines crossing each other in the centre; these are the two diagonals and the two diameters. The children should now count and describe the different lines, angles, and figures, that they see on their paper.

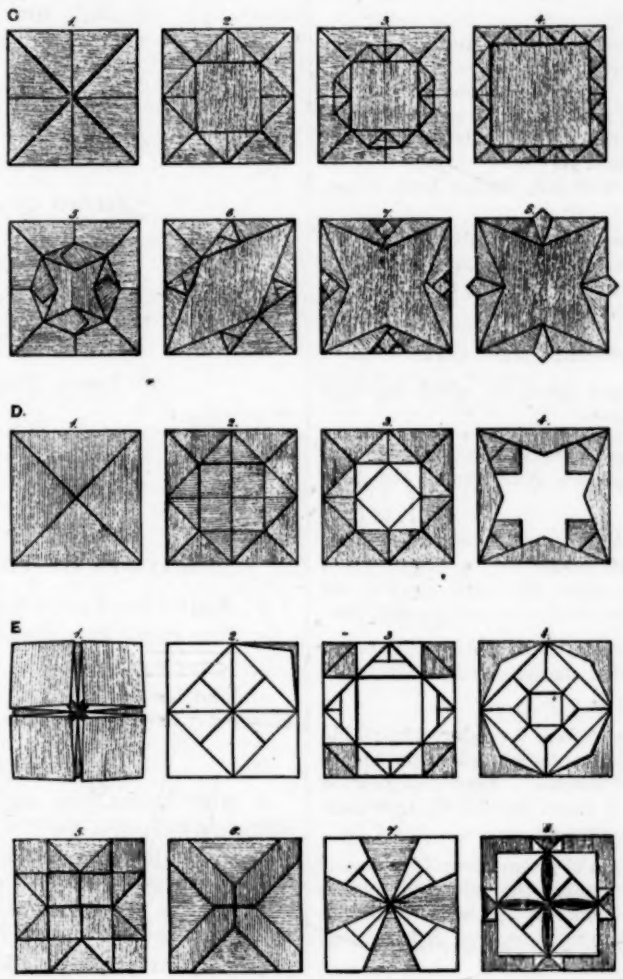

Plate XLIII.

If children are sufficiently advanced, other geometrical forms may be made, *e.g.*, pentagon, hexagon, trapezium, rhomboid, rhombus, and octagon. Children taught in this way will readily distinguish and understand these geometrical figures.

II. Simple objects.

The children should be provided with squares of paper, which should be folded in order to mark the diameters and diagonals. The children should point to the centre of the square and then fold the right top corner exactly to that spot. If this is turned with the folded edge to the bottom, the children will see that they have made something resembling a ship in full sail. Now fold the left top corner to the centre. These two corners folded over form a triangle, and the whole looks like a house, the triangle forming the roof.

The three corners folded to the centre gives the form of an open envelope, and the fourth one folded, that of a closed envelope, a pocket handkerchief case, or a scent packet. On one side of this form, the children see four triangles folded over, with the apexes all touching in the centre, on the other side is a square divided by diagonals and diameters into eight triangles.

The children turn the squares upwards and fold all the corners over to the centre. When this is done, they will see four little triangles, and if they turn their form on to the other side they will see four little

squares. From this form several objects may be folded, *e.g.*, cruet, vegetable dish, work basket, etc.

The children should learn how to fold a windmill. The following directions will be necessary:—

The diameters and diagonals to be found, the bottom and top horizontal edges folded to the middle horizontal line, and the right and left perpendicular edges folded to the middle perpendicular line; when the paper is opened, the children will see sixteen small squares. Each of the corner squares has the diagonal through it.

The perpendicular and horizontal lines to be again folded to the middle, each corner square is then to be folded in, its diagonal being drawn out and placed outside, thus making a right angled triangle at each corner of the square, forming the sails of the windmill. From the windmill very many objects may be made, *e.g.*, vase, boat with sail, double boat, purse, box, picture frame, etc.

It is almost impossible to describe, briefly, in words, or by illustrations, the way in which these objects are made. Teachers must see them made in order to learn how to do them.

III. Star forms. (Plate XLII. and XLIII.)

There are five ground forms on which the star forms are made, they are—

(A) The four corners of the square are folded to the centre, and the triangles thus formed are used for making star forms.

(B) Ground form (A) is turned over and the four corners of the square are folded to the centre. On turning the paper over again four little squares are seen, and these are used for the second ground form.

(C) If ground form (B) is turned over, the children will see four divided triangles; these are used for the third ground form.

(D) The fourth ground form is produced by taking ground form (A) and folding the corners of the square to the centre, over the triangles. Four triangles are again produced, and if these are raised, four little squares will be seen underneath.

(E) The fifth or windmill ground form is produced from the windmill by opening the sails and folding them so that the outer points of the sails touch the centre of the square, then there are four little squares on the large square.

Star forms, *i.e.*, pretty and regular forms are made on these ground forms, by folding the corners certain distances either backwards or forwards. The forms produced are innumerable, and are calculated to cultivate the children's love of the beautiful, and to give them a taste for regular and symmetrical forms. Paper folding also makes them clean, neat, and accurate in their work; givest hem dexterity of hand, develops a love of order and arrangement, and at the same time offers a wide field for the display of their inventive powers.

(To be continued.)

Quarterly Arithmetical Tests.

BY JOSEPH WOLLMAN,

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STANDARD I.—FIRST QUARTER.

1. 305
41
7
280
69

2. 694
560

3. 875
341

4. A man walked 28 miles on Monday, 19 on Tuesday, and 35 on Wednesday. How many miles did he walk altogether?

SECOND QUARTER.

1. 58
763
9
42
970

2. 416
408

3. 378
92

4. There are 547 children in a school, and 285 are boys How many are girls?

THIRD QUARTER.

1. 527
190
415
804
638

2. 503
444

3. 725
38

4. A boy had 63 marbles. He lost 28, and won 35. How many had he then?

STANDARD II.—FIRST QUARTER.

1. 48,936 + 52 + 6,708 + 69,074 + 390 + 5,613.

2. Take 10,768 from 38,050.

3. 79,605 × 37.

4. John has 156 marbles, and Robert has 38 less. How many have they together?

SECOND QUARTER.

1. What is the product of nine hundred and sixty-eight and eight hundred and sixty-nine?

2. Divide thirty thousand four hundred by five, and write the answer in words.

3. What is the difference between 57,103 and ninety thousand one hundred?

4. Mary has 50 pennies, Jane twice as many, and Anne half as many. How many pennies have they together?

THIRD QUARTER.

1. What is the eleventh part of 84,678?

2. How much greater is 31,472 than 8,576?

3. 590 × 7,080.

4. A boy had three hundred nuts. He kept 92 for himself, and divided the remainder among eight of his playmates. How many did each get?

STANDARD III.—FIRST QUARTER.

1. Divide five hundred and three thousand and eighty by sixty-seven.

2. How many times will 29 exactly divide one million ninety-eight thousand eight hundred and ten?

3. Multiply the difference between 69,057 and 95,703 by 790.

4. What is the five hundred and eighty-fourth part of four hundred and two thousand nine hundred and sixty?

SECOND QUARTER.

1. What is the sum of £208 17s. 6½d., five thousand and ninety pounds thirteen shillings and ten pence, £36 18s. 7¾d. eight pounds sixteen shillings and four pence halfpenny, £7,650 12s. 9¼d. and fifteen shillings and eleven pence three-farthings?

2. If 3,706 trees had to be planted in 38 orchards and 97 in each orchard, how many would be left unplanted?

3. Take seventeen shillings and three pence three-farthings from one hundred pounds one shilling and a penny farthing.

4. A boy saved 5s. 3½d., 4s. 10½d., and 6s. 5½d. in three months. How much must he save in the fourth month to have just a sovereign?

THIRD QUARTER.

1. Find the difference between seventy-six thousand and nineteen pounds and ten pence and half a million pounds and five pence.

2. At a concert 58 persons paid 4s. each, 97 paid 3s. each, 264 paid 2s. each, and 573 paid 1s. each. How many shillings were taken altogether?

3. £765 12s. 8½d. + £6,040 17s. 5¼d. + £59,307 13s. 10¾d. + £86 9s. 7¼d. + £17,439 10s. 9½d. + £8 14s. 2¾d. + £41 18s. 6½d.

4. John has 5s. 9d. and Thomas has 2s. 10½d. more than John. How much have they together?

STANDARD IV.—FIRST QUARTER.

1. Divide £700 and a crown by 29.

2. £3,628 16s. 10¾d. × 470.

3. A soldier is paid 1s. 3d. per day. How much will 986 soldiers receive weekly?

4. A railway, 308 miles long, cost making £64,646 12s. 8d. What was the cost per mile?

SECOND QUARTER.

1. Bring seventy thousand and ninety halfpence to pounds.

2. Find the cost of 19 pieces of silk, each measureing 84 yards, at £4 15s. 6d. for a dozen yards.

3. Reduce 3 sq. miles 2 roods 9 sq. yards to sq. feet.

4. A box of oranges, containing seven hundred, was bought for two guineas. There were 38 bad ones, and the remainder were sold at a penny each. How much was gained?

THIRD QUARTER.

1. A clock ticks every second. How many times will it tick in 15 days 19 hours?

2. Reduce a quarter of a million quarts to quarters.

3. A chest of tea containing 5 cwt. 1 qr. 24¾ lbs. was made up into 129 packets. How many ounces did each packet contain?

4. Thomas saves 1½d. a day, and William saves 2s. 8½d. every calendar month. How much will they have together at the end of a year.

STANDARD V.—FIRST QUARTER.

1. What would be the cost for 2 miles 3 fur. 34 po. 2¾ yds. at £2 6s. 8d. per furlong?

2. Find the cost of 6,094 articles at 13s. 11¾d. each.

3. How much land would be required for 275 gardens, if each contains 2 ro. 22 po. 22 sq. yds.?

4. Find the total value of 768 articles at two guineas each, 768 articles at £1 10s. each, 768 articles at 9s. 6d. each, and 768 articles at 5s. 9d. each.

SECOND QUARTER.

1. If a boy can write 1,440 words in three-quarters of an hour, how long would it take him to write eight thousand words?

2. If a bankrupt pay 13s. 9d. in the £, what will a creditor lose on a debt of £509 10s.?

3. How many horses can be bought for £1,488 17s. 4d., if 34 horses cost £1,581 18s. 5d.?

4. Bill:—

17 shirts at 5s. 11d. each;
11 collars at 6½d. each;
13 pairs of cuffs at 11½d. per pair;
9 ties at 1s. 4½d. each;
35 handkerchiefs at 10s. 6d. per dozen;
14 pairs of stockings at 2s. 9d. per pair.

THIRD QUARTER.

1. $\frac{7}{9} + \frac{5}{6} - \frac{3}{8} + \frac{4}{3} - \frac{3}{3}$.

2. Find the least number which will contain the numbers from 1 to 12.

3. Add $\frac{5}{8} - \frac{4}{7}$ to $\frac{3}{5} - \frac{2}{3}$.

4. A field will afford pasturage for 36 cows for 8¼ weeks. How many cows must be sent away that it may last 13½ weeks?

STANDARD VI.—FIRST QUARTER.

1. Divide ·026175 by ·00375, and subtract the quotient from 100.

2. Simplify $(3\frac{1}{9} \div 5\frac{5}{6}) \div (4\frac{1}{4} \div 6\frac{1}{3})$.

3. If an English sovereign is worth 25·25 francs, how many sovereigns are worth 984¾ francs?

4. Simplify:—

$$\frac{3\frac{5}{6} - 2\frac{7}{8}}{4\frac{8}{9}} \div 5\frac{1}{2}\frac{3}{9}.$$

SECOND QUARTER.

1. Reduce ·392875 of 7s. 6d. to the decimal of a sovereign.

2. If 17 cwt. 3 qrs. 20 lbs. cost £9 8s. 3d., how much can be bought for £24 15s.?

3. What is the value of $7\frac{1}{2}$ miles × ·485?

4. How much greater is $\frac{4}{7}$ of $4\frac{1}{5}$ of 4s. 7d. than $\frac{5}{6}$ of ·306 of 10s. 5d.?

THIRD QUARTER.

1. What is the interest on £378 2s. 6d. for $3\frac{1}{2}$ years at $2\frac{3}{4}$ per cent.?

2. If £15 12s. is gained as interest in 39 days, in how many weeks would £86 16s. be gained?

3. What sum of money must be put out at $2\frac{1}{4}$ per cent. to produce £150 interest in 2 years?

4. At the morning attendance of a school $\frac{6}{7}$ of the children were present. In the afternoon there were 15 more present, and the attendance was $\frac{9}{10}$ of the number of children. How many children attended the school?

STANDARD VII.—FIRST QUARTER.

1. If 8 men, working $10\frac{1}{2}$ hours a day, can reap 350 acres in 6 days, how many men, working $11\frac{1}{4}$ hours a day, will reap 500 acres in $5\frac{1}{3}$ days?

2. A, B, and C can do a piece of work in 4 days. B can do it in 10 days, and C in 15 days. In what time could A do it?

3. What principal will amount to £704 11s. $1\frac{1}{2}$d. in 3 months at $5\frac{1}{2}$ per cent?

4. If $13\frac{3}{4}$ tons be carried 280 miles for £5 19s., how far would $38\frac{1}{2}$ tons be carried for a third of the money?

SECOND QUARTER.

1. A boy was told to multiply a fraction by $\frac{5}{6}$, but he divided it by $\frac{5}{6}$, and the result was $\frac{77}{270}$ too much. What was the fraction?

2. A farmer sold 7 cows at $15\frac{1}{2}$ guineas each, 9 at £$14\frac{1}{2}$ each, and 8 at $16\frac{1}{2}$ guineas each. What was the average price?

3. In what time will £270 amount to £321 12s. 9d. at $4\frac{1}{2}$ per cent.?

4. The average age of 27 boys is $12\frac{1}{2}$ years. Five of them are 14 years, 7 are 13 years, and 9 are 10 years. What is the average age of the remainder?

THIRD QUARTER.

1. If penny newspapers are bought at 8d. per dozen, and 13 are given to the dozen, what is the gain per cent., and how much would be gained on an outlay of £30?

2. Two houses were bought for £345 each. One was sold at a gain of $12\frac{3}{4}$ per cent., and the other at a loss of $7\frac{1}{4}$ per cent. What was the net gain?

3. The sum of £4 16s. was divided among 5 men, 6 women, and 7 children, so that for every shilling a man got, a woman got 9d. and a child got 2d. What was a man's share?

4. A watch was sold for £18 10s. at a loss of $7\frac{1}{2}$ per cent. What ought it to have realised to give a gain of $7\frac{1}{2}$ per cent?

ANSWERS.

STANDARD I.

	FIRST.	SECOND.	THIRD.
1.	702.	1,842.	2,574.
2.	134.	8.	59.
3.	534.	286.	687.
4.	82 miles.	262 girls.	70 marbles.

STANDARD II.

	FIRST.	SECOND.	THIRD.
1.	130,773.	841,192.	7,698.
2.	27,282.	6,080.	22,896.
3.	2,945,385.	32,997.	4,177,200.
4.	274 marbles.	175 pennies.	26 nuts.

STANDARD III.

	FIRST.	SECOND.	THIRD.
1.	7,508 + 44.	£12,996 15s. $1\frac{3}{4}$d.	£423,980 19s. 7d.
2.	37,890 times.	20 trees.	1,624 shillings.
3.	21,050,340.	£99 3s. $9\frac{1}{2}$d.	£83,690 17s. $2\frac{1}{2}$d.
4.	690.	3s. $4\frac{1}{2}$d.	14s. $4\frac{1}{2}$d.

STANDARD IV.

	FIRST.	SECOND.
1.	£24 2s. 11d. + 5d.	£146 0s. 5d.
2.	£1,705,557 1s. $0\frac{1}{2}$d.	£635 1s. 6d.
3.	£431 7s. 6d.	83,657,061 sq. ft.
4.	£209 17s. 10d.	13s. 2d.

THIRD.

1. 1,364,400 times.
2. 976 qrs. 4 bus. 2 pks.
3. 76 ounces.
4. £3 18s. $1\frac{1}{2}$d.

STANDARD V.—FIRST.

1. £46 6s. 11d.
2. £4,259 9s. $0\frac{1}{2}$d.
3. 176 ac. 2ro. 10 po.
4. £3,350 8s.

SECOND.

1. 4 hrs. 10 min.
2. £159 4s. $4\frac{1}{2}$d.
3. 32 horses.
4. £5 0s. 7d. + 5s. $11\frac{1}{2}$d. + 12s. $5\frac{1}{2}$d. + 12s. $4\frac{1}{2}$d. + £1 10s. $7\frac{1}{2}$d. + £1 18s 6d. = £10 0s. 6d.

THIRD.

1. $1\frac{133}{160}$.
2. 27,720.
3. $\frac{1081}{1716}$.
4. 14 cows.

STANDARD VI.

	FIRST.	SECOND.	THIRD.
1.	93·02.	·147328125.	£36 7s. $10\frac{1}{2}$d.
2.	$\frac{44}{45}$.	2 tons 7 cwt. 16 lbs.	31 weeks.
3.	39 sovs.	3 miles 5 fur. 4 po.	£3,333 6s. 8d.
4.	$1\frac{88}{89}$.	9s. $2\frac{3}{4}$d.	350 children.

STANDARD VII.

	FIRST.	SECOND.	THIRD.
1.	12 men.	$\frac{1}{3}$.	$62\frac{1}{2}$ %; £18 15s.
2.	12 days.	£15 19s. $2\frac{1}{4}$d.	£18 19s. 6d.
3.	£695.	$4\frac{1}{2}$ years.	9s.
4.	$33\frac{1}{3}$ miles.	14 yrs. 5 mos.	£21 10s.

Practical Perspective for Pupil Teachers.

BY

E. G. BAKER, B.SC., B.A.,

Vice-Principal of the Training College, Carmarthen.

III.

PARALLEL HORIZONTAL LINES.

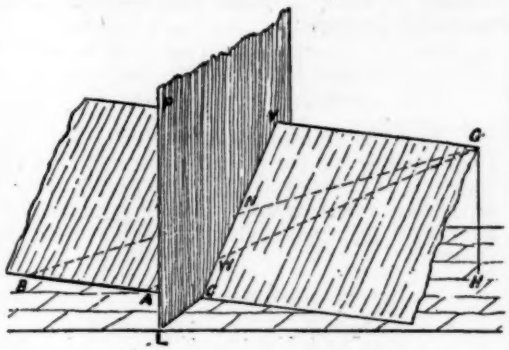


Fig. 19.

THE figure here given, the various details of which were explained under fig. 19, enables us to deduce the following principles:—

1. For every horizontal line such as AB, in whatever direction drawn, the point V is on the picture plane *at the height of the eye* (GH) *above the picture line*. Every such point as V is therefore on a *horizontal line* on the picture plane at the level of the eye. This line, KS in preceding figures, is called *the horizontal line*. We shall henceforth mark it by the letters HL.

2. The point V was obtained by drawing through G a line parallel to AB. Thus for *every line parallel to AB*, whose projection we require, the point V is the same. This point is called the *vanishing point* of lines parallel to AB. If we suppose AB to make a certain angle, *e.g.*, 60°, with the picture plane to the right, then V is called the vanishing point for lines receding at 60° to the right. It should be carefully noted that V is the vanishing point for *every line* in the same direction as AB, no matter at what level the lines are drawn. Hence we obtain the rule:

'*Parallel lines in perspective vanish to the same point.*'

We will now give a few problems in which this principle is applied, and first the student should re-work the following exercise, following the directions.

EXERCISE.—Make a perspective drawing of the square described below, as it appears to an eye 4 ft. above its plane, and 6 ft. from the picture plane; scale ½ in. to the foot.

The square lies in a horizontal plane, and has sides 2 ft. long. The nearest angle is 1 ft. to the left, and 1 ft. in the picture, and one side recedes at 45° to the right.

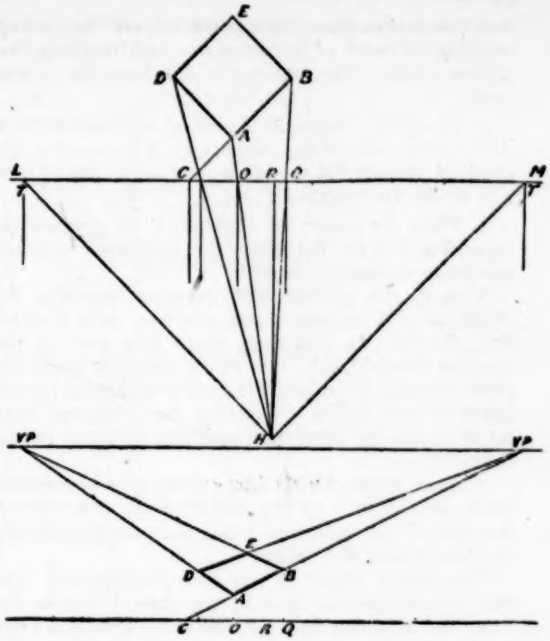


Fig. 25.

To be re-worked to full scale by aid of the directions given below.

DIRECTIONS.—First, taking the upper half of the paper to represent the plane in which the square lies, draw LM, the picture line, and HR at right angles to it and 6 ft. long by scale. Then by scale find the position of A, the nearest angle of the square, and draw AB, receding to the right at 45° and 2 ft. long. On it construct the square ABED. Take the lower part of the paper to represent the picture plane, and draw LM, the picture line, and also HL, the horizontal line 4 ft. above it. Find the vanishing points, VP, for AB and AD as usual. Next produce BA to C, and transfer C to the picture plane by means of your squares. Join C and the VP on the right, and the perspective of AB is on this line. Draw the lines from A and B to H as usual, and transfer the points O and Q where they cut LM, to the same line on the picture plane. The perpendiculars drawn as before give A and B. The last two steps may be shortened, and the work rendered neater, by simply marking the points where the perpendiculars would cut CV. The student will easily see how to do this without even actually transferring the points O and Q. Now join A on the picture plane to the VP on the left. The perspective of the side AD is on this line, and A is found. Find D as usual.

Now DE in the square is parallel to AB; therefore its perspective projection vanishes to the same point as the projection of AB. Join therefore D on the picture plane to VP on the right. The side DE is on this line, and one end of it is D. Similarly, join B on the picture plane to VP on the left, and the angle E is found.

PROBLEMS.

Scale ½ in. to the foot.

Solutions to be kept for comparison with one another.

1. Place in perspective a rectangle lying on the ground plane, sides 4 ft. and 3 ft. long. The 4 ft. sides make angles of 50° with the picture plane towards the right, and the nearest angle is 2 ft. to the left and 1 ft. in the picture. The spectator is 5 ft. high, and stands 8 ft. away from the picture plane.

2. Place in perspective a square in a horizontal plane 3 ft. below the spectator's eye, the sides of which are 4 ft. long. Two of the sides make angles of 40°

with the picture plane towards the left, and the nearest angle is in front of the spectator and touching the picture plane. The spectator is 8 ft. from the picture plane.

3. Place the rectangle described in Problem 1 in perspective, everything respecting it remaining unchanged, except that the plane in which it lies is now 2 ft. below the spectator's eye.

4. Place the square of Problem 2 in perspective, supposing it to be 6 ft. below the spectator's eye, but otherwise similarly situated.

Now if the student will examine carefully the solutions of Problems 1 and 3 above, he will notice that, for the two problems, there is a part of the solution identical, viz., that which depends upon the plane in which the object lies, and in which the picture plane is not shown. Reading the problems once more it will be seen that both are included in the following:—

Place in perspective the base and top of a rectangular solid, base 4 ft. × 3 ft., height 3 ft., &c., the remainder of the statement being as in the second and third sentences of Problem 1.

The picture plane, in this new problem, will have two picture lines on it, viz., the ground line for the base, and a picture line 2 ft. below the spectator's eye for the top.

Again, if we suppose Problems 2 and 4 to be the base and top of a rectangular solid on a square base, standing on the ground plane, then they may be combined, and a problem stated as follows:—

Place in perspective the base and top of a rectangular solid on a square base, sides 4 ft. long. The solid is 3 ft. high and stands on the ground plane. The spectator is 6 ft. high.

The remaining particulars are easily supplied, being stated in 2 and 4 above.

Fig. 26 shows the solution of this latter problem, worked to a scale of $\frac{3}{16}$ in. to 1 ft., and the student should re-work it to a scale of $\frac{1}{2}$ in.

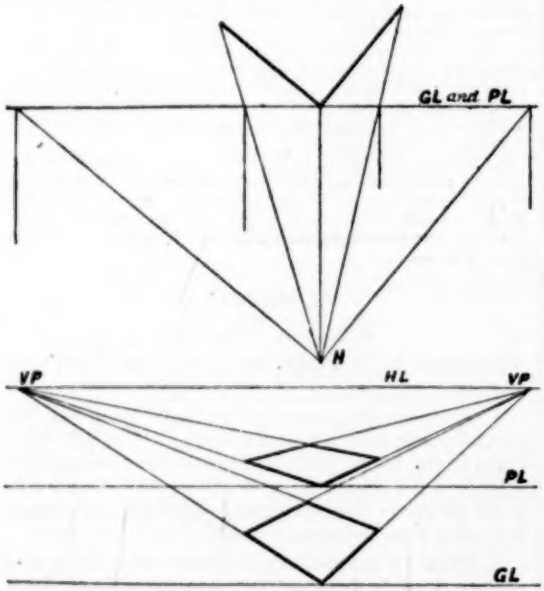


Fig. 26.

DIRECTIONS.—Only half the square need be drawn in the plan, for the other half can be completed by means of the vanishing point. Between GL and HL is 6 ft., since the spectator is 6 ft. high. Between PL and HL is 3 ft., since the top of the solid is 3 ft. below the spectator's eye. The rest of the construction contains nothing strange, but note that the top and base can be drawn simultaneously.

N. B.—If the angles of the two projections be joined by perpendiculars, all the angles and edges of the solid are obtained.

The following exercises should present no difficulty, but we work the first. It will render the problems easier if solids resembling those mentioned be placed somewhat in the positions described, and rough sketches of them be made before entering on the work of projection.

PROBLEMS.

Scale $\frac{1}{2}$ in. to the foot.

1. Draw the representation of a cube, edges 3 ft. long, standing on the ground plane with its nearest angle 3 ft. to the left and 1 ft. in the picture, two sides of the base vanishing to the right at 45°. The spectator is 5 ft. high and stands 8 ft. away from the picture plane.

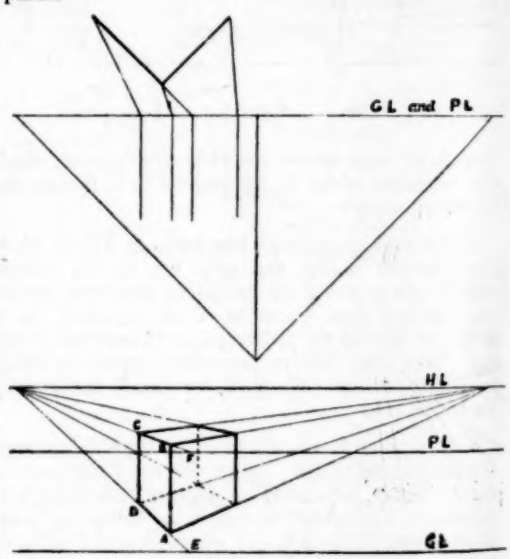


Fig. 27.

Scale $\frac{3}{16}$ in. to the foot.

N. B.—Those edges of the solid which are not seen by the spectator are dotted. The working of the following problems will be made much neater if the lines to the vanishing points be not drawn further than required.

2. Draw the perspective projections of the rectangular solids described below, as seen by a spectator 6 ft. high and 10 ft. from the picture plane, the solids standing on the ground plane.

(*a*) Base 4 ft. × 3 ft. Height 2 ft. The long sides of the base recede from the picture plane towards the right at angles of 40°, and the nearest angle of the base is 3 ft. to the left and 1 ft. in the picture.

(*b*) Base 3 ft. × 2 ft. Height 4 ft. The long sides of the base vanish as in (*a*), and the nearest angle is 3 ft. to the right and 2 ft. in the picture.

3. Place in perspective the rectangular solids described below as seen by a spectator 4 ft. high and 11 ft. from the picture plane, the solids standing on the ground.

(*a*) Base 5 ft. × 3 ft. Height 6 ft. The long sides of the base recede from the picture plane towards the left at angles of 50°, and the nearest angle of the base is 1 ft. to the left and 1 ft. in the picture.

N.B.—The top is here above the spectator's eye, so that the picture line for it will be above the horizontal line. Moreover, only two sides of the top will be visible. The other two must be shown by dots. (Compare fig. 24).

(*b*) Base 1 ft. × 4 ft. Height 5 ft. The long sides of the base recede towards the right at angles of 40°, and the nearest angle is 2 ft. to the right, and touching the picture plane.

It will be a useful exercise if the pupil now sketch a cube or other rectangular solid from various points of view, chosen to illustrate the principles which have so far been demonstrated. The solution shown in fig. 27 should be studied, and it will be observed that the amount of space occupied by a drawing of a rectangle or square, which is horizontal, is less as the distance of the figure below the eye of the observer diminishes.

We now proceed to prove the following theorem :—

The perspective projection of a line parallel to the picture plane is parallel to the line.

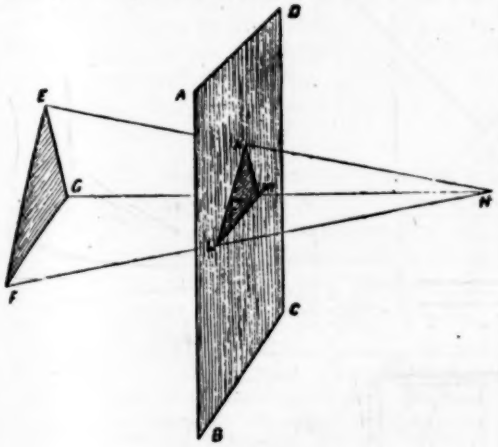


Fig. 12.

The truth of this statement will easily be gathered from fig. 12, here reproduced. The line KL is the projection of EF. Now if EF be parallel to the plane, it will never meet that plane however far produced, and therefore it will never meet KL. But EF and KL are in the same plane, the plane HEF. Now lines in the same plane which never meet, however far they may be produced, are parallel. Therefore, EF is parallel to KL, *i.e.*, the *projection is parallel to the line itself, when that line is parallel to the plane.*

This principle will be applied now for horizontal lines parallel to the plane, but it must not be forgotten that it is true for all lines parallel to the plane, *e.g.*, the vertical edges of the solid in fig. 27.

EXERCISE.—Place in perspective a square lying on the ground, with two sides parallel to the picture plane. The sides of the square are 2 ft. long, and the nearest angle is 1 ft. to the right, and 1 ft. in the picture; spectator 4 ft. high and 6 ft. from the picture plane.

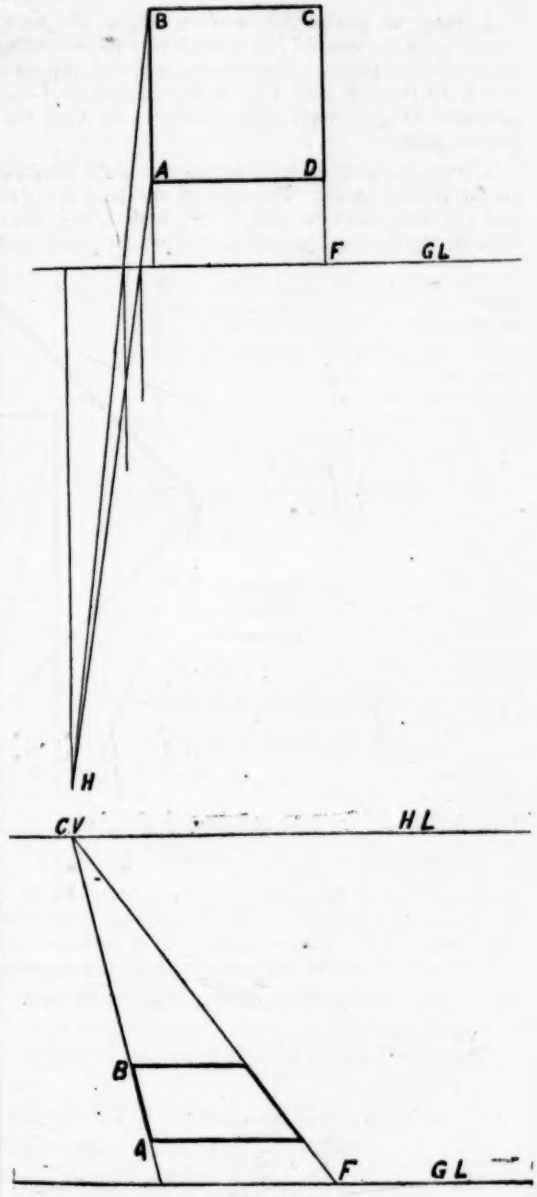


Fig. 27A.

The method of working may be gathered from the fig. 27A. The side AB is first obtained as usual by finding its VP. For a line which makes 90°, as this does, with the picture plane, the VP is evidently where the line of direction cuts the plane. It is marked CV, and is called the *centre of vision*, for a reason which the pupil will easily see if he consider the cone of fig. 15. Having obtained AB, next produce CD to F, and transfer F to the picture plane. Join F to the vanishing point CV, and the perspective of DC is on this line. Now, since AD and BC are parallel to the picture plane, and the projection of AB is found, the projections of AD and BC are obtained by drawing horizontal lines simply. Note that a vanishing point for AD cannot be found.

After working the above the student will have no difficulty with the following problems :—

PROBLEMS.

Scale $\frac{1}{2}$ in. to the foot.

1. Place in perspective a cube, edges 4 ft. long, standing on the ground plane, with two faces parallel to the picture plane. The nearest angle of the solid is 1 ft. to the left, and 1 ft. in the picture, and the spectator is 5 ft. high and stands 10 ft. from the picture plane.

2. Place in perspective a rectangular slab standing on the ground plane. The sides of the base are 5 ft. and 1 ft. long, and the slab is 7 ft. high. The short sides of the base are parallel to the picture plane, and the nearest angle is 3 ft. to the right and 1 ft. in the picture. The spectator is 4 ft. high and 11 ft. from the plane of projection.

EXERCISE to be re-worked by the student after reading the directions.

Place in perspective a slab with a base 4 ft. square and thickness 1 ft., standing on the ground plane with the sides of the base receding from the picture plane to right and left at 45°, and the nearest angle 2 ft. to the left and 1 ft. in the picture. On it stands centrally a rectangular solid on a base 2 ft. square. Its height is 5 ft., and two faces of it are parallel to the picture plane. The spectator is 5 ft. high, and stands 8 ft. away from the picture plane.

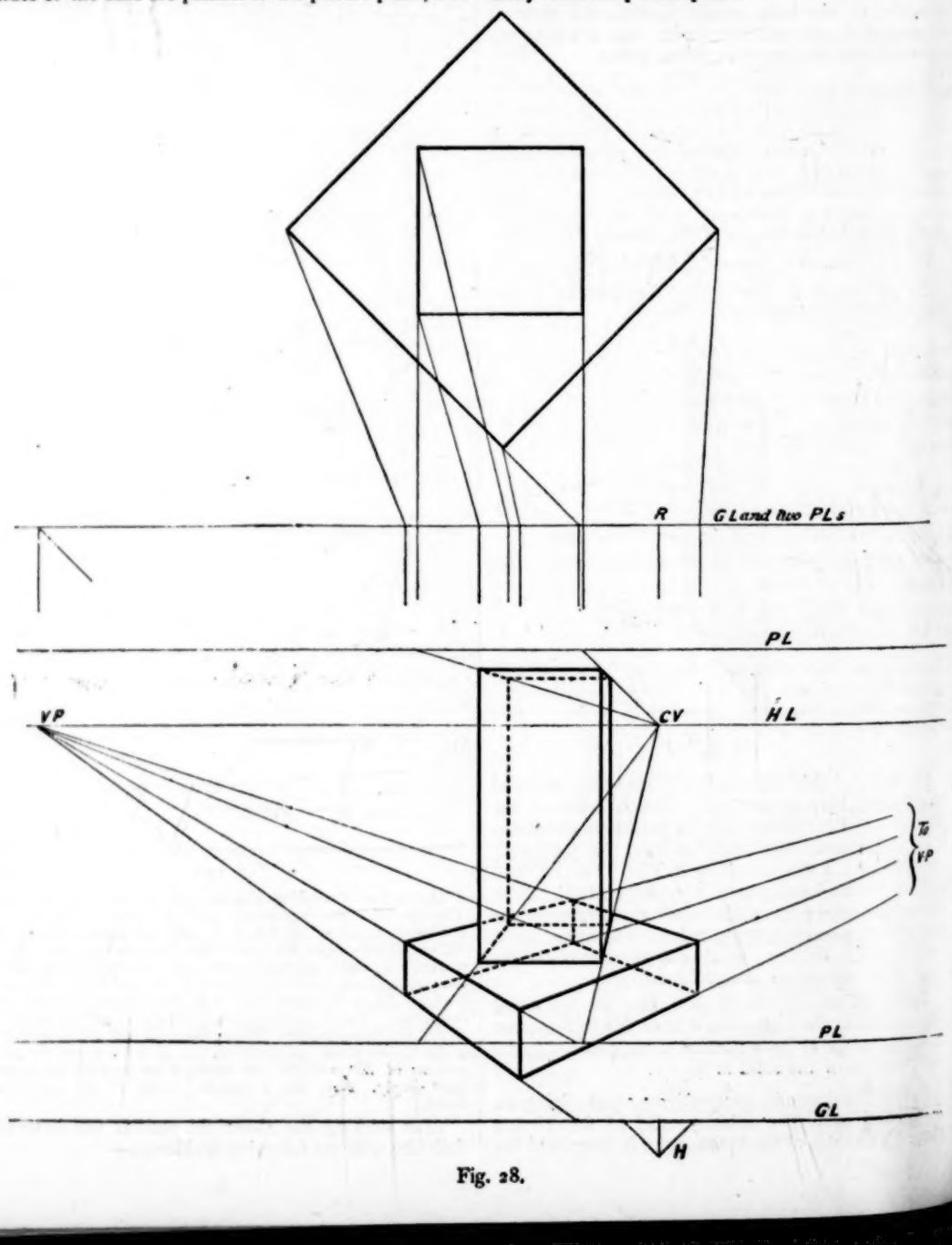


Fig. 28.

DIRECTIONS.—First place the lower solid in perspective as usual. The picture line for its top is 1 ft. above the ground line. Next draw the plan of the other solid, the centre of the square base coinciding with the centre of the top of the slab, and two sides parallel to the picture plane. Now the top of this solid is 5 ft. above its base, and the picture line for the base of it is the same as for the top of the slab.

The picture line for the top is above the horizontal line. Place this solid in perspective, using the right picture lines and vanishing point, by the usual method. The presence of the slab must be forgotten. It does not affect the method of procedure in the least.

Note that to save space a part of the paper is used to represent the picture plane which has in all previous problems been unoccupied. Henceforth the student will find it advisable to place the point H near the lower edge of his paper and draw his ground line or lowest picture line close above it. The lines drawn to enable us to find the vanishing points need only be shown partially as in fig. 28.

PROBLEMS.

Scale $\frac{1}{2}$ in. to the foot.

1. A cube stands on the ground plane with two sides of its base receding to the right at 50° with the picture plane. The centre of its base is 3 ft. to the left and 4 ft. in the picture, and the edges of the cube are 3 ft. long. Centrally on this is placed a slab 1 ft. thick, with the sides of its base, which is 5 ft. square, parallel to the sides of the top of the cube. Make a perspective drawing of the two solids, supposing the spectator to be 5 ft. high, and to stand 10 ft. away from the picture plane.

2. Fig. 29 is the plan to half scale of a frustrum of a square pyramid standing on the ground. The angle A is 2 ft. to the left and 1 ft. in the picture, and AB recedes from the picture plane at an angle of 40° to the right. The frustrum is 4 ft. high. Draw the perspective representation of it for a spectator 6 ft. high and 8 ft. from the picture plane.

(First place the plan in the proper position and draw the base in perspective. Then, using a picture line 4 ft. above the ground line, place the top in perspective. Then join the angles of the two squares for the edges of the frustrum.)

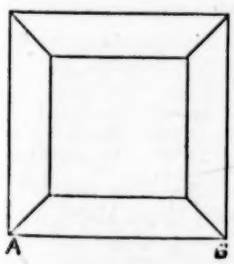


Fig. 29.

3. Fig. 30 gives the plan and elevation to half scale of a square slab standing on the top of a frustrum of a square pyramid. The side AB vanishes to the right at 50° and A is 2 ft. to the right and 1 ft. in the picture. Spectator 4 ft. high and 9 ft. away from the picture plane.

N.B.—The positions of the picture lines on the picture plane are obtained from the elevation.

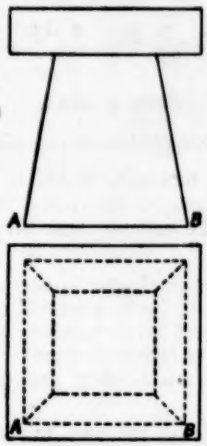


Fig. 30.

(To be continued.)

Contracted Arithmetic.

BY J. L. RICHARDSON.

SECTION XIX.

To Square Numbers from 13 to 99 inclusive.

To the number to be squared add its unit digit, and annex a cypher to the right. Multiply the result by the tens digit of the original number, and add to this the square of the unit digit first taken.

Example:—Required the square of 78.

78 + 8 = 86, which, adding 0, becomes 860.

Multiplying by the tens digit we have 860 × 7 = 6020.

The square of the unit digit is 8 × 8 = 64.

Then 6020 + 64 = 6084. Answer.

Square the following numbers:—

EXERCISE XXII.

1. 13. 2. 16. 3. 19. 4. 24. 5. 31. 6. 46. 7. 53. 8. 65. 9. 76. 10. 82. 11. 91. 12. 17. 13. 27. 14. 18. 15. 36. 16. 14. 17. 43. 18. 54. 19, 67. 20. 79.

SECTION XX.

To Square two-digit numbers ending with 5.

Multiply the tens digit by that next in order above it, as 6 × 7, 7 × 8, 8 × 9, &c., and on the right of the product place 25. Thus, in squaring the number

65, we see that 7 is the next higher digit to 6, which multiplied by 7 produces 42. Annexing 25 we have the answer, 4225.

Square the following :—

EXERCISE XXIII.

1. 15. 2. 25. 3. 35. 4. 45. 5. 55. 6. 65. 7. 75. 8. 85. 9. 95.

SECTION XXI.

To Square three-digit numbers ending with 25.

Add half the hundreds figure to the square of itself, and attach 4625 to the result. If the hundreds figure be odd, take half the next lower number and annex 5625.

Example :—Required, the square of 725. Noting first that 7, the units figure, is an odd number, we take half of six, the next lower number, which gives 3 to be added to 49, the square of seven. Thus we obtain 52, to which we attach 5625, and get the answer, 525625.

Not so expeditiously the sum might be worked as follows :—Attach two cyphers to the number ; multiply by the hundreds figure, and add a fourth of the top line, thus :—

¼)72,500 a hundred times 725.

7

507,500. Top line multiplied by the hundreds digit.
18,125. A fourth of top line.
525,625. Answer.

Square the following :—

EXERCISE XXIV.

1. 125. 2. 225. 3. 325. 4. 425. 5. 525. 6. 625. 7. 725. 8. 825. 9. 925.

SECTION XXII.

The Square of Doubled Numbers.

The square of any doubled number is equivalent to the square of the number multiplied by four.

Find the double, square, and proof of the following numbers, thus :—

2 doubled = 4. 4 squared = 4 × 4 = 16. Ans.
2 squared = 4. 4 × 4 = 16. Proof.

EXERCISE XXV.

1. 2. 2. 4. 3. 6. 4. 8. 5. 3. 6. 5. 7. 7. 8. 9. 9. 10. 10. 12. 11. 14. 12. 16. 13. 13. 14. 15. 15. 17. 16. 19. 17. 23. 18. 34. 19. 45. 20. 56.

SECTION XXIII.

The Cube of doubled numbers.

The cube of any doubled number is equivalent to the cube of the number multiplied by eight.

Find the double, cube, and proof of the following numbers, thus :—

4 doubled = 8. 8 cubed = 8 × 8 × 8 = 512. Ans.
4 cubed = 64. 64 × 8 = 512. Proof.

EXERCISE XXVI.

1. 2. 2. 3. 3. 4. 4. 5. 5. 6. 6. 7. 7. 8. 8. 9. 9. 10. 10. 11. 11. 12. 12. 13. 13. 14. 14. 15. 15. 16. 16. 17. 17. 18. 18. 19. 19. 23, 20. 34.

SECTION XXIV.

Division by 10, 100, 1,000, &c.

Though division does not so readily lend itself to contraction as multiplication does, there are several instances in which the work may be curtailed. The present section, being simply the converse of Section 6. will be easily understood. Mark off, by a dot or comma, from the right of the dividend, as many digits as there are cyphers in the divisor. The figures on the left of this mark form the quotient, and those on the right of it the remainder.

Example :—87453 ÷ 1000 = 87 + 453.

EXERCISE XXVII.

By 10. 1. 3,876. 2. 4,567. 3. 3,894. 4. 75,492. 5. 86,571. 6. 38,467.
By 100. 7. 2,567. 8. 39.849. 9. 54,213. 10. 98,275. 11. 51,823. 12. 91,986.
By 1,000. 13. 38,965. 14. 24,897. 15. 35,619. 16. 210,046. 17. 82,957. 18. 738,424.

ANSWERS.

EXERCISE XXII.

1. 169.	2. 256.	3. 361.	4. 576.	5. 961.
6. 2,116.	7. 2,809.	8. 4,225.	9. 5,776.	10. 6,724.
11. 8,281.	12. 289.	13. 729.	14. 324.	15. 1,296.
16. 196.	17. 1,849.	18. 2,916.	19. 4,489.	20. 6,241.

EXERCISE XXIII.

1. 225.	2. 625.	3. 1,225.	4. 2025,	5. 3,025.
6, 4,225.	7. 5,625.	8. 7,225.	9. 9,025.	

EXERCISE XXIV.

1. 15,625.	2. 50,625.	3. 105,625.
4. 180,625.	5. 275,625.	6. 390,625.
7. 525,625.	8. 680.625.	9. 855,625.

EXERCISE XXV.

1. 16.	2. 64.	3. 144.	4. 256.
5. 36.	6. 100.	7. 196.	8. 324.
9. 400.	10. 576.	11. 784.	12. 1,024.
13. 676.	14. 900.	15. 1,156.	16. 1,444.
17. 2,116.	18. 4,624.	19. 8,100.	20. 12,544.

EXERCISE XXVI.

1. 64.	2. 216.	3. 512.	4. 1,000.
5. 1,728.	6. 2,744.	7. 4,096.	8. 5,832.
9. 8,000.	10. 10,648.	11. 13,824.	12. 17,576.
13. 21,952.	14. 27,000.	15. 32,768.	16. 39,304.
17. 46,656.	18. 54,872.	19. 97,336.	20. 314,432.

EXERCISE XXVII.

1. 387 + 6.	2 456 + 7.	3. 389 + 4
4. 7,549 + 2.	5. 8,657 + 1,	6. 3,846 + 7.
7. 25 + 67.	8. 398 + 49.	9. 542 + 13.
10. 982 + 75.	11. 518 + 23.	12. 919 + 86.
13. 38 + 965.	14. 24 + 897.	15. 35 + 619.
16. 210 + 46.	17. 82 + 957.	18. 738 + 424.

(To be continued.)

How a Scotch School was Examined.

INFANT DEPARTMENT.

Reading.—The books used were Collins' First and Second Infant Readers. Some pupils here and there in each class were asked to read.

Writing.—A line from one of the reading books was written on blackboard by the teacher, and then copied on slates by the children.

Arithmetic.—Taken by Inspector in usual way, and then such questions as, 'If a man went to bed at 9 o'clock at night and slept till 6 o'clock next morning, how many hours did he sleep? How many are in a score? a dozen? half-a-dozen? two score?' &c.

Object Lesson.—'The Turtle' given by a pupil teacher.

Singing.—A few notes on modulator and one action song.

The teacher was allowed to choose some girls for sewing.

STANDARD I.

Reading.—Books: Chamber's Graduated Reader Part I., and Nelson's Royal Reader I. Some pupils asked to read from the former and some from the latter.

Arithmetic.—Pupils sat back to back and worked the two following sums:—(1) 47 + 806 + 558 + 387 + 490. (2) From 905 take 790.

After working these the pupils changed slates and corrected them, after which the Inspector went round and examined them.

Writing.—One line was transcribed from reading book and the Inspector looked at one slate here and there in class.

Singing.—Some notes on modulator and two songs.

Sewing.—Six girls were selected by teacher for the sewing.

STANDARD II.

Reading.—Books used: Chambers' Graduated II., and Nelson's Royal Series II. Three poetry lessons and two prose were taken from the former, and two lessons from the latter. The Inspector chose a pupil at random, and the teacher examined the class on one of the lessons read to test the intelligence.

Dictation.—'When this was observed the covering was removed, and the utmost joy was shown by the group on finding the young ones alive and unhurt.' To correct errors the pupils changed slates and the teacher spelt the words over. Thereafter the Inspector examined slates.

Arithmetic.—Three sums, similar to those given below, were read in words. The pupils were placed back to back and when they had finished their work, slates were exchanged and sums corrected. Inspector looked at slates and took a note of how many sums were correct.

(1) 2078 + 9034 + 7008 + 9809 + 7898 + 7989 + 8659.

(2) From 9005 subtract 7009.

(3) Multiply 9758 by 6.

Singing.—Notes were taken from modulator, and two songs were taken from a list of seven.

Sewing.—The teacher was allowed to choose eight girls for sewing.

STANDARD III.

Reading.—Books used: Chambers' Graduated and Nelson's Royal Reader III. Some of the pupils read from the former both poetry and prose. The poetry for repetition was the 'Village Blacksmith.' From these lines grammar and intelligence were tested as well as from reading lessons.

History.—Some questions about the Reformation and the persons connected with it. General questions also from Queen Mary's reign.

Geography.—General questions—rivers—mountains—firths, &c., of Scotland.

Arithmetic.—

A. (1) 62,265,864 ÷ 852.

(2) £7,000 15s. 1d. — £566 13s. 4¾d.

(3) 580,371 × 6,070 } in words.
(4) 88,750 ÷ 69 }

B. (1) Find the difference between sixty-three thousand and four and eight thousand and twenty-eight.

(2) 73,068 × 3,806.

(3) 4,996,314 ÷ 357.

(4) £709 0s. 8½d. + 18s. 11¾d. + £900 9s. 9d. + £78 17s. 7¼d. + £60 9s. 3¾d.

C. (1) 580,371 × 7,080 } in words.
(2) 63,004 × 8,028 }

(3) 4,996,314 ÷ 574.

(4) £81 14s. 7½d. + £510 3s. 8d. + £7,446 18s. 11¾d. + £8 13s. 5¼d.

D. (1) 48,820 ÷ 67 } in words.
(2) 581,073 × 570 }

(3) 890,765 × 890.

(4) 39,018,675 ÷ 1,497.

Singing.—One song taken. and the following exercise was written on blackboard as a singing test:—

Key C.

s : d¹ : d¹	t :-.f :	l : l : l	s :-.m : m	}
s : l .s : f .m	m :-.r : r	r : m :-.r	s :— :—	}
s .,t : l :-.s	m¹ :-.r¹ : d¹.l	s : m .,s : r .s	m :— :	‖

Dictation.—'But his daughter, a frail girl, who had never taken an oar except in the calmest weather, urged him to the rescue, and offered to go with him. The father could not be less brave than his young daughter. The boat was launched, and each taking an oar they were soon tossing among the waves.'

STANDARD IV.

Reading.—All read from Chambers' Graduated, No. V. Poetry recited, 'The Wreck of the Hesperus.' Intelligence and Grammar were taken from Stanzas 3, 11, 14, 15.

Geography.—A comparison of England, Scotland, and Ireland, as regards rivers, lakes, and mountains. Questions on English manufactures in the north.

History.—General questions on the reigns of James I. and Charles II.

Dictation.—'Inspired with new hope, Colder redoubled his exertions, but strained himself to such a degree that the blood flowed from his mouth and nostrils, and streamed down his breast. He arrived within a mile of the river. The sounds of footsteps gathered upon him. A glance behind him showed his pursuer within twenty yards, and preparing to launch his spear. Preparation, encouragement, recollecting, tremendous, disappeared, descending, sufficient, atmosphere.'

Arithmetic—

A. (1) £78 14s. 8¾d. × 579.

(2) How many stones in 8 tons 3 qrs. 14 lbs.?

(3) How many crowns in 289,560 halfpence?

(4) Divide £243,204 0s. 9¾d. by 273.

B. (1) Divide £208,673 11s. 8¼d. by 789.

(2) Reduce 84,063 minutes to weeks.

(3) How many threepenny pieces in £785 15s. 9d.?

(4) Multiply £98 16s. 7¼d. by 687.

C. (1) Multiply £79 16s. 7¼d. by 786.

(2) Reduce 897,648 halfcrowns to florins.

(3) How many inches in 1 mile 36 yards? (1,760 yards = 1 mile).

(4) Divide £108,675 18s. 8¾d. by 987.

Music Test on blackboard. See Standard V.

STANDARD V.

Reading.—Taken From Chambers' Graduated, No. VI.

Repetition.—'Lady of the Lake.'

Composition.—A story from Tolstoï.

History.—Growth of the Indian Empire under Clive and Hastings.

Geography.—Mountains of Europe and how these determine the courses of rivers.

Arithmetic.—

A. (1) 8528 articles at £1 17s. 8¾d. each.

(2) Bill:—17 lbs. at 9½d. per lb.; 39 lbs. at 1s. 3¼d. per lb.; 100 eggs at 10½ per dozen.

(3) If 4 horses cost £75 12s., What must be given for 72 cows of which three are worth 1 horse?

(4) Divide $\frac{1}{8} + \frac{1}{4}$ by $\frac{1}{4} - \frac{1}{8}$.

B. (1) 675 yds. at £18 18s. 9d. per yd.

(2) A farmer pays a rent of £2,500 at £1 5s. 9d. per acre; what must he pay at £1 1s. 5½d. per acre?

(3) Bill:—17 yds. at 5s. 6d. per yd.; 14 yds. at 1s. 10d. per yd.; 35 yds. at 8s. 4d.; 60 dresses (each 15 yds.) at 6s. 8d. per yd.

(4) From ¾ of 5½ take $\frac{2}{3} + \frac{3}{5} + \frac{5}{6}$.

Music Test.—Key D.

m : s :r.m	f :m.m :r.d	t_1.d : r : s_1	m : s :r.m		
r.m :f.r : d	r :-.r :m.r	d : .l_1,s :f.m	r : r : d		

STANDARD VI.

Reading.—Chamber's Graduated Reader, both prose and poetry taken for reading, grammar, and intelligence.

Composition.—Essay on 'Spring' or a 'Fox Hunt.'

Repetition.—Same as Standard V. Meaning and grammar of the piece well handled in every way.

History.—Mostly confined to the Crimean War and Indian Mutiny. Some questions on the first Reform Bill and its promoters.

Geography.—India: its products, climate, and commerce with other colonies and the mother country.

Arithmetic.—

A. (1) Simplify $\dfrac{\frac{2}{11} \text{ of } 12\frac{6}{7}}{\frac{3}{5} \text{ of } \frac{5}{6\frac{2}{3}}} \div 1\frac{3}{11}$

(2) If 16 men can reap 40 acres in 6 days of 9 hours each, how many hours a day must 36 men work to reap 35 acres in 3 days?

(3) Find the interest on £740 for 4½ years at 4¼ per cent.

(4) Divide the sum of ·075 and ·0075 by the difference between 7·5 and ·75.

B. (1) After paying income-tax of 8d. in the pound, a person's income was £541 6s. 8d. Find the amount on which the tax was paid.

(2) What quantity of soap at £·025 per lb. will cost 19·575 florins?

(3) Reduce £8 9s. 3d. to the fraction of £21 12s. 9d.

(4) At what rate per cent. will £380 amount to £433 4s. in 3½ years at 4 per cent.?

Music Test.—Key D.

: s	s :-.m :m.m	m : d : .d	r :-.m :f,m,r				
: m	m :-.d :d.d	d : d : .d	s_1 :-.d :r,d,t				
m :— : .s	s :-.m :m.m	m : d : .d	r :-.m :s,f,r				
d :— : .m	m :-.d :d.d	d : d : .d	s_1 :-.d :m,r,t_1				
d :— : .d	r :-.r :r.r	m.f : s : .s	l :-.s :m.d				
d :— : .d	t_1 :-.t_1 :t_1.t_1	d.r : m : .m	f :-.m :d.m				
r :— : .r	r :-.t_1 :r.r	m.f : s : s	d' :s.m :f.r				
s :— : .t_1	t_1 :-.t_1 :t_1.t_1	d.r : m : m	m :d. :r.t_1				
s :— : .s	d :s.m :s,f,r	d :—					
m :— : .m	m :m.d :m,r,s_1	m_1 :—					

Sewing.—The sewing of this Standard and that of the Fifth was taken together.

An Elementary Course in the Use of Wood Working Tools.

BY FRED. WILKINSON, F.G.S.,

Science Teacher under the Bolton School Board.

SIXTH TOOL: SAW.

WE next propose to deal with one of the most common of wood-working tools, viz., the saw. There are, roughly speaking, six kinds of saws used, viz. :—

1. Rending or ripping saws.
2. Hand or cross cutting saws.
3. Tenon or back saws.
4. Dovetail saws.
5. Compass saws.
6. Panel saws.

The above differ in form, size, and arrangement of teeth. It will be seen later on why these differences, which are so essential, should exist. That saw which performs its work with little force is a good one. For example, let us suppose we have two saws before us, one of which performs a cutting exercise with a certain amount of work. If the second does the same thing with one half the work, we say at once the latter is twice as efficient as the former. The cut made by a saw in the wood is called the 'kerf,' and a wide kerf implies that more work has been necessary to remove the timber in cutting than a narrow would have done. Two things decide whether the kerf shall be wide or narrow—set and thickness of blade.

It will be apparent that the thinner the blade the thinner the cut or 'kerf' will be, and a saw which is thin and will stand the strain put upon it in thrusting it forward is a saw to be desired.

It will also be noticed that the blades of the hand, ripping, and compass saws all taper. This is done to prevent bending in sawing, and it is found from experience that by so tapering the blade narrow at the point and wider towards the handle, this undesirable property of bending is minimised. It must also be noticed that the saw blade thins, too, from the teeth to the edge or back of saw. But it is found that this is not sufficient to prevent the saw from becoming blocked in the kerf. That is to say, suppose we are cutting with a saw whose teeth lie as shown in fig. 54,

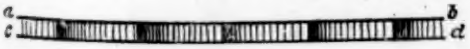


Fig. 54.

that is, they do not project over the lines *ab* and *cd*. We should very soon observe that greater force would be required to thrust such a saw through the kerf. Each tooth does its own work in cutting and requires fair room to do that work in.

Now to get over the difficulty of sticking or scotching in the kerf the alternate teeth are bent a little in opposite directions. This is shown in fig. 55.

Fig. 55.

The action of this alternate bending is soon seen if we refer to fig. 56, which shows a cut made by a ripping saw when used with the grain of the wood.

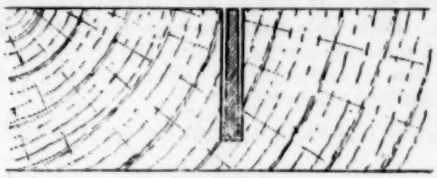


Fig. 56.

It leaves room for the easy working of the blade, and less force is consequently required to thrust the saw forward.

This bending of teeth is technically known as 'set.'

It will be seen then that the greater the set the greater will be the ease with which the saw will work. Let us next consider the action of a single tooth when working upon a piece of wood. Fig. 57 shows a ripping saw, which is drawn on a scale of $1\frac{1}{2}$ in. to 1 ft.

Fig. 57.

An ordinary ripping saw should have a blade about 24 inches long with 6 teeth to the inch. Thus when we see 6 teeth or 8 teeth it means there are 6 or 8 teeth to the inch.

Let fig. 58 represent a portion of a ripping saw slightly enlarged.

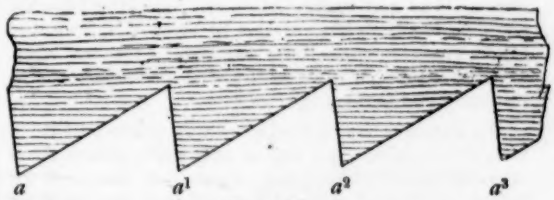


Fig. 58.

We must observe that the points a, a^1, a^2, &c., act like ordinary chisels, except that their action is neither so clean nor so well done.

Let us next suppose the ripping saw is applied to a block as shown in figure 59.

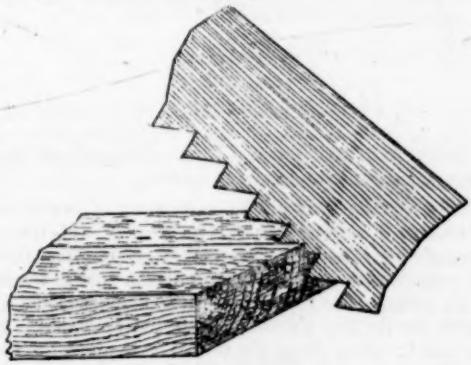


Fig. 59.

We must first put the saw upon the mark along which it is required to saw with the grain. Let the handle be low at the start, so that in drawing the saw towards the body a small kerf may be made by the teeth. Each little tooth, we have said, works like a chisel, removing a small portion of the fibrous wood each time it passes over the ends of it. The particle thus cut is shown in fig. 59.

Fig. 60 represents a single tooth. The angle we

Fig. 60.

find is considerably greater than that of the cutting tool named in our last, viz., the plane iron which we stated to be about 35°. Fig. 61 shows the cutting tool again, and a rough idea may be obtained how great the difference between the two angles is by comparing the two sections.

Fig. 61.

As a cutting tool, then, this single tooth is not so good as a chisel, because we have in the increased angle of the tooth less power to cut. But it may be urged, Why not make the tooth have the desired angle? Well, we find, if this be attempted, that the teeth are very materially weakened, for we must remember that great strain is put upon each tooth in thrusting and pulling in sawing.

We stated at the beginning of this article that there were six kinds of saws, but we may really classify them into two great classes, viz., those that are used for cutting with the grain and those that are used for cutting across the grain. See fig. 62.

Fig. 62.

Exercise XIII.

Sawing with the grain.—Take a flat piece of wood about 3 feet by 6 inches by 2 inches.

True up the four sides preparatory to our sawing exercises. Now put it upon two trestles and lay out a line an inch from the face edge on the face side. This may easily be done by taking the rule in the left hand, putting the first finger under the rule, and the thumb on the top about one inch from the end. Set the rule to one inch on the timber, and place the right thumb on the top of the rule, the blacklead resting against the end of rule and first finger of right hand, gently keeping lead in position. Now step back and draw the lead and rule together, pressing the first finger of left hand gently against the wood to keep the rule from slipping.

Let fig. 63 represent board in position on trestles.

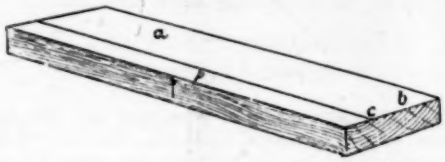


Fig. 63.

Now place right knee in position *a*, and with left hand take a firm grip of the end at *b*. Place the saw in position *c*, and first draw towards the body and a kerf will then be made. Allow the saw to work lightly, and do not unduly force it in the working or it may get cogged and double work will be necessary.

Apply gentle pressure as it is sent from the body, keeping the saw in a plane perpendicular to the kerf, and also taking care to keep the line in view that a straight cut may be obtained. When near the trestle push the board out so as not to cut the former. When a sufficient distance is cut the saw may be placed between the trestles, and a wedge inserted in the kerf. This will open the cut and make the sawing exercise much easier.

For a second exercise, on cutting with the grain. On the piece left, which will now be 4 in. wide, run a line 2 inches from the edge again, and continue the line over the ends and down the other side. Now place the board in the bench vice in the position indicated by fig. 64.

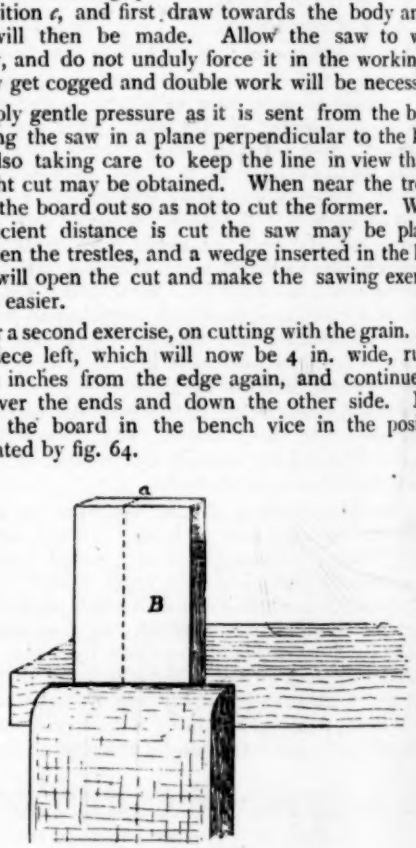


Fig. 64.

Saw down the line this time. Begin at point *a* and tilt up the handle of the saw, beginning as before near the handle, and draw towards the body, forming a good kerf. Now, gently lowering the saw, it may be made to assume a horizontal position. The sawing may now go on until the vice is reached, then the piece should be reversed and sawn through.

Now take the piece marked B and mark a line ½ in. from the edge, as shown in fig. 65. Continue the line on the other side.

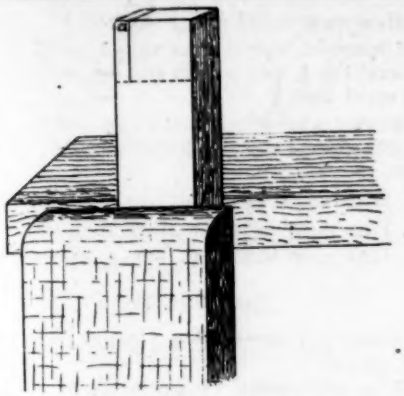


Fig. 65.

A line 2 inches from the end of piece should also be marked with the gauge as shown in fig. 65.

Now saw with grain again, but this time beginning at the nearer side, at point *a*. The saw's handle this time must be down and the point up. Saw a kerf on line *a*, and gradually assume a horizontal position as before, and go down as far as the horizontal line.

The next saw to claim our attention is the hand saw or cross-cut saw. Just for the sake of enforcing what we have to say regarding cross-cut saws, let the student take up the ripping saw again. Lay any of the pieces cut on the trestles or in the vice, and try to cut across the grain with it. The pupil will notice two things at once—(1) difficulty to obtain a kerf, and (2) great splintering and tearing of the fibres. This arises from the fact that the ripping saw is only constituted for cutting the ends from the fibres, and not for cutting the fibres in two, which is necessary when we wish to cut across the grain. This difficulty, however, is got over by using a cross cutting saw.

Fig. 66 shows the arrangement of teeth in this saw.

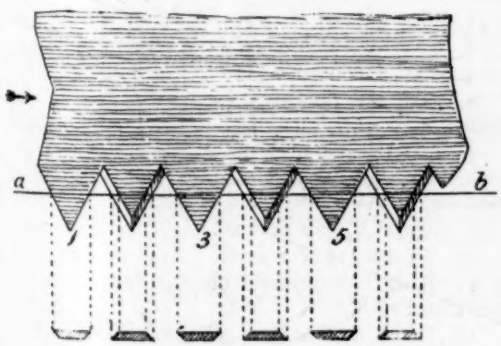


Fig. 66.

In order to avoid breaking and tearing the fibres the teeth are arranged altogether differently in this saw. We notice, as before, that there is set in the teeth. There is a bending of alternate teeth also, one to one side and the next tooth bent in the opposite direction. But if we look carefully we find that every tooth which forms an equilateral triangle has its edge ground, as shown in fig. 66; and this grinding is done on alternate sides of the teeth. Teeth 1, 3, and 5 are ground on the under side. Thus a section made across the cross cut saw in direction of line *ab* would give us what we see in the lower half of fig. 66.

Now look in direction of the arrow down the blade, and we find we get something like what we see in fig. 67.

Fig. 67.

When the cross-cut saw then is applied to wood the teeth are very much like chisels and cut as shown in fig. 68.

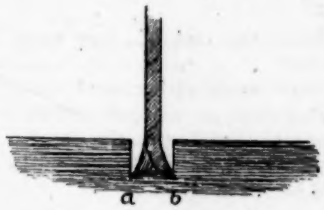


Fig. 68.

The teeth at *a* and *b* (fig. 68) cut into the wood, and the friction between the cut fibres and the teeth breaks up the scored wood, and, as the saw is moved, the dust is removed.

Exercise XIV.

We now propose sawing with the cross-cut. Take the piece which measures 3 ft. by 2 in. by 2 in. True up the four faces and lay the piece on the bench.

Now take the rule and measure on it points 3 in., 2 in., 1 in., ½ in. and ¼ in. from the end as shown in fig. 69.

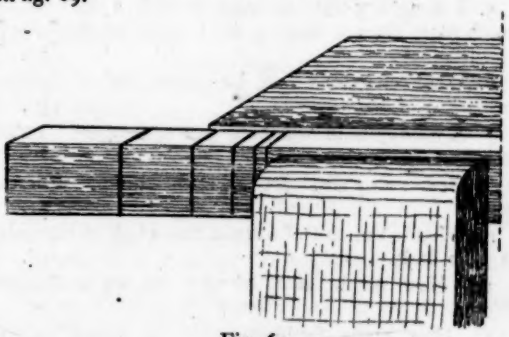


Fig. 69.

By means of set square, square over the lines on all four sides, so that the excellence or otherwise of sawing exercise may be seen.

Place the piece in the vice as indicated and, taking the cross-cut saw firmly in the hand, make a kerf first at points *a*, *b*, *c*, *d*, and *e*, and assume horizontal positions as before. Great care must be taken when the pieces are nearly sawn through that splintering does not happen. This may be avoided by holding the pieces gently, and keeping them up until sawing is completed.

(To be continued.)

Tests in Mental Arithmetic.

STANDARD I.

1. A boy had 30 nuts. He ate 14, and gave 10 away. How many had he left? 6.
2. Add together 7½d. and 8½d. 1s. 4d.
3. How much more is wanted to make half-a-crown? 1s. 2d.
4. A boy wanted to buy a book which cost 1s. 2d., and he put away 2d. every week. How long would it be before he could buy it? 7 weeks.
5. If he saved 3d. weekly, how long would it take? 5 weeks.
6. In that case how much would he have to spare? 1d.
7. If 3 lbs. of rice cost 9d., how many lbs. could you get for 1s.? 4.
8. How much would 2½ lbs. cost? 7½d.
9. In a class there are ten girls and twice as many boys. How many are there in the class? 30.
10. If half and three more went out to play, how many would be left in school? 12.
11. If a couple of fowls cost 7s., what is one worth? 3s. 6d.
12. If one is worth 3s. 3d., what would a couple cost? 6s. 6d.

STANDARD II.

1. Add together 2 score, 3 dozen, and 8. 84.
2. What would 84 oranges cost at 8d. per dozen? 4s. 8d.
3. If I want to give 60 boys a penny each, how much more than 4s. 8d. is required? 4d.
4. What is the cost of 28 penny stamps and 28 halfpenny ones? 3s. 6d.
5. I bought 5 lbs. of sugar at 2½d. a lb. How much more than a shilling did I want to pay for it? ½d.
6. What change would be given out of half-a-crown? 1s. 5½d.
7. A railway train will hold 540 passengers. How many are there when it is half full? 270.
8. How many lbs. are there in a stone and a half? 21.
9. What is the cost of a stone and a half of currants at 3d. a lb.? 5s. 3d.
10. How much short of £5 are 93 shillings? 7s.
11. How many farthings must be added to 93 farthings to make a florin? 3.
12. How much short of a double-florin are 93 half-pence? 1½d.

STANDARD III.

1. What is a thousand times a thousand? 1 million.
2. Divide a million by 200. 5,000.
3. Divide 5,000 by 200. 25.
4. How many times is 25 contained in a million? 40,000.
5. What is the cost of 54 oranges at 8d. per dozen? 3s.
6. How many could you get for 10d? 15.
7. I wanted to buy 3 score eggs a 1s. 3d. at score, but found I had only a florin and ten pennies. How much was I short? 11d.
8. At that price what would 2 eggs cost? 1½d.
9. What would half-a-gallon of milk cost at 1½d. a pint? 6d.
10. What would 5½ gallons cost? 5s. 6d.
11. How many inches are there in 2½ feet? 30.
12. How many inches are there in 2½ yards? 90.

STANDARD IV.

1. How many pencils at 4 a penny could you get for 1s. 3½d.? 62.
2. How much would 87 pencils cost? 1s. 9¾d.
3. What is the cost of a cwt. of potatoes at 8d. a stone? 5s. 4d.
4. What would 2½ cwt. cost? 13s. 4d.
5. What would a stone of sugar cost at 2½d. a lb.? 2s. 11d.
6. What would a stone and a half cost? 4s. 4½d.
7. If ¼ lb. of butter cost 4½d., what will 7 lbs. cost? 10s. 6d.
8. How many twopences could be given away out of half-a-guinea? 63.
9. How many threepences could you give? 42.
10. If 3 yards of cloth cost 18s., what would 8 yards cost? £2 8s.
11. What is the eighth part of a crown? 7½d.
12. What part of half-a-crown is 10d.? ⅓.

STANDARD V.

1. If 4d. be saved daily, how much will be saved in 197 days? £3 5s. 8d.
2. If 3 yards of cloth cost 17s., what will 5 yards cost? £1 8s. 4d.
3. What fraction of a sovereign is 1s. 2d.? $\frac{7}{240}$.
4. What fraction of a crown is 4½d.? $\frac{3}{40}$.
5. What fraction of a yard is 8 inches? $\frac{2}{9}$.
6. Take the difference between ⅓ and ¼ from unity. $\frac{11}{12}$.
7. Take the sum of ⅓ and ¼ from 2. $1\frac{5}{12}$.
8. If I spend ⅓ of a shilling, and then ⅛ of the remainder, how much would be left? 7d.
9. Express $\frac{7}{20}$ as a decimal. ·35.
10. What is ·35 of 2 tons? 14 cwt.
11. What is the interest on £40 for 3 years at 10 per cent.? £12.
12. If the interest was £60 what would be the principal? £200.

STANDARDS VI. AND VII.

1. What must I do to 3·607 to make it ·003607? Divide by 1,000.
2. What must I do to it to make it 360.7? Multiply by 100.
3. Subtract 3·607 from 360·7. 357·093.
4. A boy spent $\frac{5}{9}$ of his money, and had 8d. left. How much did he spend? 10d.
5. If he had spent 4d., what fraction of his money would he have had left? $\frac{7}{9}$.
6. What percentage is 7 of 9? $77\frac{7}{9}$ per cent.

7. What percentage is 9 of 7? 128$\frac{4}{7}$ per cent.

8. How many boys can do half as much as 16 men, if a boy can do $\frac{1}{3}$ the work of a man? 24.

9. If £30 amounts to £42 in 4 years, what is the rate per cent.? 10 per cent.

10. In what time would it amount to £50? 6$\frac{2}{3}$ years.

11. If an article is sold for 27s. at a loss of 10 per cent., what is the cost price? £1 10s.

12. If it had been sold for 36s., what would have been the percentage of gain? 20 per cent.

—o—

Our Certificate Class.

BY DR. GEORGE BEACH, M.A.

Co-author of 'Our Mother Tongue,' &c., Head Master of Christ Church Schools, Macclesfield.

GENERAL REMARKS.

1. On p. 6 of Form IX. the words '*Christmas Examination*' should be written after the name of any teacher who desires permission to attend the next examination for Certificates.

2. In the June issue we desire to call special attention to THE PAPER ON PARAPHRASING, by C. J. Dawson. This so clearly shows that Paraphrasing is an intellectual and not a mechanical exercise, so plainly exhibits what should be imitated and what avoided, that after its careful and repeated study proficiency should be obtained by the minimum of practice.

IN THE QUERY COLUMN, Solutions 1, 2, 3, 5, 6 of *Algebra*, 1 of *Mensuration*, 1 and 2 of *Geometry*, and 1 and 2 of *Arithmetic* will well repay close attention.

3. *The Government do not propose to apply the distinction between trained and untrained teachers in Art.* 73 *of the Code to any who pass the examination for Certificates before* 1*st January*, 1891.

4. A special edition of Mr. Palgrave's 'Golden Treasury,' which is usually published at 4s. 6d., will be supplied *direct* to certificate candidates only, on receipt of 2s. 6d. cash, by Messrs. Macmillan.

5. Male candidates who are weak in Arithmetic should, in addition to their own exercises, carefully work the Female Questions, and study the hints given in the Answers. As Arithmetic is both a failing subject, and one in which the ladies are generally weak (despite Miss Fawcett's achievements), we are devoting particular attention thereto.

6. We can strongly recommend to the notice of our readers Moffatt and Paige's 'New Geography,' which by selection of matter, arrangement, accuracy, clear diagrams, and examinational features is exceptionally suited to Certificate candidates.

7. Every student should now as soon as possible procure a copy of the New Code and study its provisions and principles.

ALGEBRA.

(1) $x^2 - x + \frac{72}{x^2 - x} = 18$. Substitute a for $(x^2 - x)$

$a + \frac{72}{a} = 18$; $a^2 + 72 = 18a$; $a^2 - 18a + 72 = 0$; $(a - 12)(a - 6) = 0$;

$\therefore (a - 12)$ and $(a - 6)$ each $= 0$, $\therefore a = 12$ and 6.

From this we obtain the equations $x^2 - x = 12$ and $x^2 - x = 6$.

ANSWERS: 3, -2, 4, -3.

(2) $x(x - 2a) = \frac{8a^4}{x^2 - 2ax} + 7a^2$. Substitute y for $(x^2 - 2ax)$

Then $y = \frac{8a^4}{y} + 7a^2$; $y^2 = 8a^4 + 7a^2y$; $8a^4 + 7a^2y - y^2 = 0$; $(8a^2 - y)(a^2 + y) = 0$; $\therefore (8a^2 - y)$ and $(a^2 + y)$ both $= 0$; $\therefore y = 8a^2$, and $-a^2$.

From this we obtain $x^2 - 2ax = 8a^2$ and $x^2 - 2ax = -a^2$.

ANSWERS: $4a$, $-2a$, a.

ANSWERS TO QUESTIONS FOR THIRD SATURDAY AND FOURTH MONDAY.

Males.

(1) 156 and 72.

(2) a^{100}, a^{-100}, a^{-100}, a^{100}, a^0 or 1.

(3) By addition we get $x^2 + 8xy + 16y^2 = 196$; $\therefore$ extracting the square root $x + 4y = \pm 14$; by substitution of x in terms of y we get

Answer: $x = 2$, $y = 3$.

(4) Every quadratic can be reduced to the form $x^2 + px + q = 0$, and of this equation, if a and b are the roots, $(x - a)$ and $(x - b)$ are the two factors; $\therefore (x - 7)$ and $(x + 3)$ are the two factors of the required equation, which is $\therefore x^2 - 4x + 21 = 0$.

(5) *A*. For only three cases can arise, viz. (*a*) where x is greater than y by the quantity n; (*b*) where y is greater than x by the quantity m; and (*c*) where $x = y$.

(*a*) n^2 is > 0

$\therefore n^2 + 2ny + 2y^2$ is $> 2ny + 2y^2$

$\therefore (n + y)^2 + y^2$ is $> 2(n + y)y$; but $n + y = x$

$\therefore x^2 + y^2$ is $> 2xy$.

(*b*) The proof is identical when $y = m + x$.

(*c*) When $x = y$ $x^2 + y^2 = 2xy$.

(5) *B*. Because x is real and positive.

$x - 1$ is not less than 0; $\therefore (x - 1)^2$ is not < 0; $x^2 - 2x + 1$ is not < 0; $\therefore x^2 + 1$ is not $< 2x$; $\therefore x + \frac{1}{x}$ is not < 2.

(6) $a - 2\sqrt{ab} + 3b$, or $a - 2a^{\frac{1}{2}}b^{\frac{1}{2}} + 3b$.

(7) Let A, B and C be the three persons, and let W = the whole piece of work.

Then A's work in one day $= \frac{1}{a}$ of the W.

" B's " " $= \frac{1}{b}$ "

" C's " " $= \frac{1}{c}$ "

$\therefore$ A + B + C's work in one day $= \left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)$ W. $= \frac{ab + ac + bc}{abc}$ W.

$\therefore$ Time taken to do $\frac{ab + ac + bc}{abc}$ W. = 1 day.

$\therefore$ " " W. $= \frac{abc}{ab + ac + bc}$ days.

(8) 2$\frac{1}{2}$ acres.

ARITHMETIC.

Females.

Answers, etc., to June Questions.

(1) £256 5s.

(2) The lengths are in the ratio of $\frac{3}{4}$ to $\frac{1}{4}$, or of $\frac{12}{16}$ to $\frac{1}{16}$, or of 15 to 16. $\therefore$ one piece is $\frac{15}{31}$, and the other $\frac{16}{31}$ of the whole wire; and their difference being 1 inch, $\frac{1}{31}$ of the wire = 1 inch. *Answer* 2 ft. 7 in.

(3) 9 for 7d. = 12 for 9$\frac{1}{3}$d. If 9$\frac{1}{3}$d. = 112 per cent., what will 120 per cent. be. *Answer* 10d.

(4) Let P = required Principal, I the Interest of that Principal, and D = the Discount.

Then P + I : I :: P : D (From Rule)

" P + I : P :: I : D

" I : P :: I − D : D

(but at 5 per cent. I = $\frac{1}{20}$ P, and from the datum I − D = £15)

$\therefore \frac{1}{20}$ P : P :: £15 : D

1 : 20 :: £15 : D

$\therefore$ D = £300 and I = £315

and P = £6,300.

(5) 4·16 per cent.

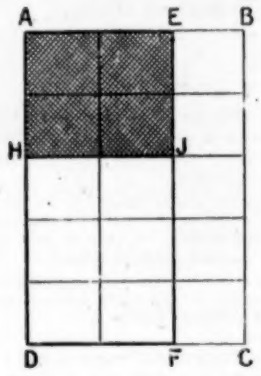
(6) Every gallon of 16s. 8d. wine sold at 19s. 2d. gains 30d.

Every gallon of 25s. 0d. wine sold at 19s. 2d. loses 70d.

The quantities to be mixed must be therefore in the inverse ratio of 30 to 70, viz., 70 : 30 or 7 : 3.

It is plain 7 galls. at 16s. 8d. + 3 galls. at 25s. 0d. = 10 galls. at 19s. 2d.

Then $\frac{7}{10}$ of the 250 galls. is the Answer, viz., 175.



(7) (*a*) Take a simpler instance : $\frac{2}{3} \times \frac{3}{5} = \frac{6}{15}$.

Construct a rectangle ABCD 5 ins. long by 3 ins. broad, and by parallel lines divide it into 15 squares of 1 inch each.

The two interior vertical lines divide the whole rectangle into thirds, and AF = $\frac{2}{3}$ of the whole rectangle.

The four horizontal lines divide AC and AF into fifths, so that AJ = $\frac{3}{5}$ of AF = $\frac{3}{5} \times \frac{2}{3}$ of AC.

But manifestly AJ = $\frac{6}{15}$ of AC,

$\therefore \frac{2}{3} \times \frac{3}{5}$ of AC = $\frac{6}{15}$ of AC.

This might also have been illustrated by dividing a straight line into fifteenths.

We leave 7 (*b*) to our Readers.

(8) (£97¼ + £¼) yields (£1 minus 3d.) ; what will £13,450 yield? £136 8s. 2$\frac{2}{11}$d. Ans.

(9) 5 horses = 12 cows = 75 sheep, ∴ 45 horses = 675 sheep, ∴ gain = 25 sheep.

If 675 sheep gain 25 sheep, what will 100 gain? Ans. 4$\frac{3}{27}$.

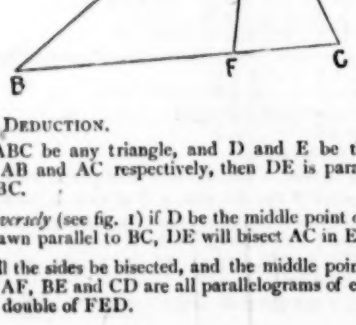
QUESTIONS SET FOR SECOND AND FOURTH SATURDAYS.

Males.

(13) Gold = 137½ ozs. ; silver = 12$\frac{5}{7}$ ozs.

(14) £2 3s. 4$\frac{4}{9}$d.

(15) This question is another excellent example of a subsidiary deduction depending upon a KEY one.



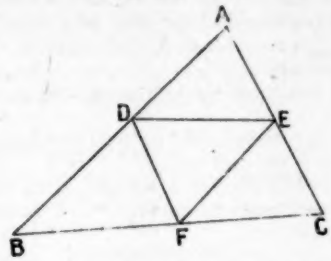
KEY DEDUCTION.

(*a*) If ABC be any triangle, and D and E be the middle points of AB and AC respectively, then DE is parallel to BC and = ½ BC.

(*b*) *Conversely* (see fig. 1) if D be the middle point of AC and E be drawn parallel to BC, DE will bisect AC in E.

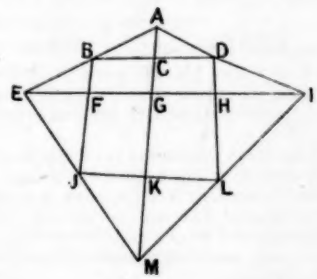
(*c*) If all the sides be bisected, and the middle points joined, the plain AF, BE and CD are all parallelograms of equal area, for all are double of FED.

(*d*) Also triangle ADE is ¼ of ABC.



(*e*) If AEMI be any quadrilateral, and B, J, L, D be the middle points of its sides, then BJLD is a parallelogram.

Join EI and AM. Then BJ is parallel to DL, for they both are parallel to AM. Also BD is parallel to JL, for they both are parallel to EI.



(*f*) In the deduction (see fig. 3) constituting Question 15 both ABC and BEF are each ¼ of AEG, or both together ½ of AEG. Similarly ACD + DHI = ½ of AGI, and LHI + LKM = ½ MGI, and JKM + JFE = ½ MGE. ∴ the 8 exterior triangles are ½ of the quadrilateral, and the remaining parallelogram BL = ½ of the quadrilateral.

(*g*) In any triangle ABC, if D and E are the middle points of AB and AC respectively, and BE and CD be joined meeting at F, then the quadrilateral ADFC = triangle BFC. For (by last month's Key Deduction) EF = ⅓ BE, ∴ EFG = ½ EBC. But triangles ADC and BEC are =, each being ½ ABC. From each of these equals take EFC, etc.

PARAPHRASING.

1. (Lines 86—105, Scene 3, Act II., Richard II.)

Address me by no title of nobility or relationship, because ignoble minds only disgrace nobility when they speak of it ; neither will I acknowledge any kinship with rebels.

Rather tell me why you, an exile, have ventured to intrude one step upon English soil. Further, how is it that you have presumed to traverse our quiet land, and by the parade of your despicable forces to scare the blood from our peasants' cheeks?

Have you dared to do this because your lawful king is absent [in Ireland]? ETC.

2. (Lines 4—26, Scene 2, Act III., Richard II.)

I cannot indeed help being well pleased. Only being back in England brings tears of gladness to my eyes. I could kiss the very ground that unfeeling traitors spurn beneath their horses' iron-shod feet.

This England is my child, whom I caress with mingled emotions, just as after a long absence an affectionate mother greets her offspring with moistened but beaming eyes.

May this dear land afford no succour to its master's enemy, nor allow its bounty to appease his wolfish hunger, ETC.

3. (Lines 36—61, Scene 2, Act III., Richard II.)

How despondingly he speaks! You are aware when the all-revealing sun is illumining the other hemisphere (which intercepts its light from us) that plunderers come confidently forth and commit their crimes with impunity; but when from below the horizon it gilds the summits of the lofty trees, and, rising, pours its rays into the haunts of vice, then, being unsheltered by darkness, assassins, traitors, and other hateful sinners, fearful of one another, are plainly exposed, ETC.

4. (Bacon's Essays, No. XVIII., '*When a traveller returneth .....*' to end of essay.)

It is well to keep in touch with the foreign countries we have visited, and not entirely to sever all connection with them.

This intercourse can be kept up by frequently writing to our most noteworthy friends abroad.

The effects of travel should not be shown by any outlandish style of dress or gesticulation; and, far from volunteering 'travellers' tales,' we should be cautious even in replying to questions, ETC.

5. (Lines 773—790, Lancelot and Elaine.)

When Elaine had obtained the desired permission from her father she glided quietly away. But whilst making her preparations for the journey, her father's last remark continually haunted her, 'As you will not be persuaded you must depart'; and this reply seemed to change and repeat itself in her heart, 'As you will not be persuaded you must depart this life.' Nevertheless her satisfaction overpowered the inward voice, just as a mother drowns her infant's cries with songs; and the thought that she might save Lancelot's life deafened her to the prophecy of her own fate, ETC.

N.B.—*The last portion of this paraphrase is rather free, but is given as an instance of the substitution of similes.*

PARSING.

1. (Lines 104—117, Scene 2, Act III., Richard II.)

Glad, that, so, like, day, drown, as, if, were, all, rage, covering, than steel, women's, by, clap.

2. (Lines 117—130, Scene 3, Act II., Richard II.)

Methinks, alive, condemned, vagabond, plucked, perforce, unthrifts, wherefore, if, that, be, cousin, had, thus, father.

3. (Lines 1—17, Scene 1., Act III., Richard II.)

Bring, Green, vex, since, must, bodies, urging, lives, for, 'twere, no, charity, from, off, here, king, unhappied, clean, have, him, broke, drawn, myself, near.

4. (Lines 83—100, Scene 2, Act III., Richard II.)

Myself, majesty, names, ye, high, be, know, enough, betide, than, tongue, deliver, him, unfold, lost, why, to be rid, as, we, so, subjects.

STORY OF LANCELOT AND ELAINE.

Elaine, the fair and lovable, of Astolat, guarded the sacred shield of Lancelot and fashioned for it an embroidered case of silk, which often she stripped off and guessed a hidden meaning in each dent. Lancelot, to her unknown, had left it with her when he went forth to fight at the tournament for a splendid diamond.

This diamond, with eight others, had formerly been found by King Arthur upon a crown encircling a skull; and he had set them apart as prizes for nine yearly tournaments. Eight successive years Lancelot had won them, but had saved them up to present them all to the queen when the tale was complete.

But on the ninth occasion he told Arthur that on account of an old wound he should not compete; for he mistakenly thought that Guinevere wished him to tarry with her.

This however was not so, for she tauntingly enticed Lancelot to contend in disguise.

Hereupon he suddenly departed and wanderingly came by chance to Astolat, where, as his shield was known to the Table Round, he left it with Elaine and borrowed one from Sir Torre, her brother.

Then being hospitably entertained, and his great nobleness shining forth in his battle descriptions, Elaine fell purely but deeply in love with him; and there suddenly flashed on her a wild desire that he should wear her favour at the tilt.

Lancelot granted her request and rode off with her brother Lavaine, whilst Elaine pondered over the entrusted shield.

On the road to Camelot Lancelot confidentially revealed himself to Lavaine and spoke with noble modesty of his own prowess.

When the joust began he took the part of the weaker side, even against his own kinsmen. These being seized with a fiery family passion for Lancelot's glory thought to bear down the stranger knight who seemed almost to outshine him.

Nevertheless he conquered, but was almost mortally wounded, and was compelled hastily to leave the field and hasten to a hermit's without even receiving the diamond.

There he lay for many a week hovering between life and death.

HISTORY.

Males.

(1) (Davies, pp. 103—120.)

Draw up a shorter summary of Norfolk's Plot, Babington's Plot and the Rebellion of Essex. Omit 'Prayer Book of Queen Elizabeth,' and closely condense pp. 113—120.

(2) (Davies, pp. 207—220.)

Omit Gremoald, Churchyard, Edwards, Tusser, Tuberville, Harrington, Heywood, Gascoyne, Hunnis, Munday, Greville, Lodge, Nash, Warner, Breton and Waton.

(3) (Davies, pp. 120—131.)

Condense pp. 120—125, master pp. 125—127, epitomise pp. 127—131.

(4) (Davies, pp. 180—187.)

Omit Richard Fox, Lord Montague, and Lord Audley. Underline the remaining important parts, and omit the residue.

HISTORY.

Females.

(1) (Davies, pp. 116—117.)

Davenant, Waller and Suckling only.

(2) (Davies, pp. 118—125.)

Summarise pp. 118—124. Omit Cartwright, Cleveland, Beaumont, Vaughan, Chamberlain, Brown.

SPENCER ON EDUCATION (pp. 33—72).

The more our readers study this valuable work, the more we are convinced will they perceive two things—1st, its originality, 2nd, its utter one-sidedness.

Most significantly does Mr. Spencer, by his example, illustrate his own remark that 'the suppression of every error is commonly followed by a temporary ascendency of the contrary one' (p. 53).

The gross and ancient error of conducting education simply on Classical lines and totally neglecting Science has led Mr. Spencer into the no less error of belittling the study of Language and magnifying the claims of Science.

John Stuart Mill is wiser, and shows that with the best teaching there is room for the profitable learning of both; whilst our author illogically argues (p. 43) that because Language is unskilfully taught that its study should be altogether abandoned.

In every way linguistic study is disparaged, its accidental vices flaunted, and its essential merits concealed.

Nowhere does Mr. Spencer acknowledge that the study of Language is the study of Nature, although he is forced to admit (p. 56) that linguistic rules are of natural growth and not of arbitrary imposition—nowhere does he show the *practical* value of a knowledge of modern languages, or the political and sociological importance of acquaintance with ancient ones.

For the prudent direction of life, for the moral guidance afforded, for the knowledge of human nature obtained, what can Science show anywise comparable to Classics?

Have our scientific professors, of whatever political complexion they may be, when they have turned politicians, been eminent for the wisdom of statesmanship?

Further, classical writings when translated into the vulgar tongue are more easily comprehended and more accurately understood than popularised science books divested of their technical terminology.

Our space forbids us to continue these remarks, but we wish our students distinctly to bear in mind that we consider 'SPENCER ON EDUCATION' AS MORE VALUABLE REGARDED AS PROVOCATIVE OF THOUGHT THAN TRUSTWORTHY AS A GUIDE.

There are, too, many slipshod expressions and many hasty generalisations mingled with much forcible writing and numerous shrewd abstractions.

The last two lines on p. 65 are surely badly worded, and instead of the terms '*definite*' and '*indefinite*,' the writer evidently should use some such terms as '*perfect*' and '*imperfect*' or '*accurate*' and '*inaccurate*.' For just later on (top line of p. 67), he properly says that the *concrete* should precede the *abstract*. Which is the more definite, the *concrete* or the *abstract*? The philosopher contradicts himself.

On p. 44 it is averred that the study of Science is the best for *moral* discipline. Here, again, there is confusion; intellectual discipline is continually being mistaken for moral. Of course all self-denying study, all honest and humble search after truth, is of high value as a moral teacher; but why the study of the facts of matter, which relate nowise to conduct, is of greater ethical value than an acquaintance with Cicero or Aristotle is beyond us to comprehend.

The following important passages should especially be noted:—

Page 34, lines 5, 4, 3 from foot; p. 35, line 5 from foot; p. 39, line 21; p. 40, line 6; p. 41, lines 13, 12, 9, 8 from foot; p. 44, lines 21, 20, 19; p. 45, lines 7, 6 from foot; p. 46, lines 21, 22, 23; p. 48, lines 16, 17; repudiate p. 48, lines 4 from foot to line 6 on p. 49; p. 50, lines 1, 2, 3; p. 52, lines 12, 11 from foot; p. 53, lines 9–14; p. 55, lines 17—20; p. 59, lines 1, 2; p. 61, lines 1—4 and 6, 5 from foot; pp. 62, 63, 64, 65; pp. 65—72, the seven principles of education.

SELECTED GOVERNMENT QUESTIONS IN ARITHMETIC FOR FIRST, SECOND AND THIRD WEDNESDAYS AND FOURTH SATURDAY.

Females.

1. Three labourers, A, B, C, working respectively 7, 8 and 9 days at the same rate of wages per day, earned altogether £3; what were the earnings of each, and what was their daily wage? Explain the working of this example. (1870.)

2. An express train to London, which travels at the rate of 45 miles an hour, leaves New Milford, 285 miles from London, at 8h. 35m. a.m.; when ought it to reach London? (1871.)

3. A waterbutt can be emptied by drawing off 20 canfuls of one size, or 30 canfuls of a smaller size; how many canfuls of each size will empty it, if the cans be used alternately? (1872.)

4. Bank Stock in October, 1873, paid 5¼ per cent. A person, after the deduction of 4d. in the £ on her dividend, received £25 16s. 3d. How much Bank Stock did she hold? (1873.)

5. Find the capital whose compound interest for two years at 5 per cent. is £28 3s. 9d. (1874.)

6. Find the size of a chess-board (on which are 64 squares), of which each square is 1⅓ ins., and the border 2¼ ins. deep. (1875.)

7. Show how to find the greatest common measure of two quantities; and find the G.C.M. of £12,148 10s. 7d. and £17,410 6s. 3d. (1876.)

8. What do you understand by ratio, and what by proportion? What is meant by saying that the terms of each ratio should not only be of the same kind, but should be brought to the same denomination? (1877.)

9. If I invest £1,638 in the 4½ per cents. at 93⅜, £5,580 in the 4 per cents. at 93, £4,780 in the 3½ per cents. at 105, what will be the average interest per cent. on my investment? (1878.)

10. Four numbers are to one another as 3, 5, 7, 11, and the sum of the two first is 128; find the four numbers. (1879.)

11. If for a loan of 30s. I receive ·25 of $\frac{1}{1\frac{1}{4}}$ of $\frac{\frac{3}{4}+\frac{1}{2}}{\frac{3}{4}-\frac{1}{2}}$ of 8 guineas, what is my interest per cent.? (1880.)

12. What is meant by Discount? Find the *True Discount* on £1,336 11s. 3d. due at the end of 3½ years at 5 per cent. per annum. (1881.)

13. Prove the rule for converting ·3$\dot{6}$ into its equivalent vulgar fraction. Express ·23$\dot{6}$ of 4s. 7d. + ·51$\dot{6}$ of 10s. as a decimal of 10s. (1882.)

14. State and explain the difference between 4 square poles and 4 poles square. How many allotments, each of 16 sq. poles 4 sq. yards, can be made out of a field of 16 acres 21 poles 4¾ yards? (1883.)

15. A time-piece started at 12 o'clock loses at the rate of 4 per cent. What is the real time when the hands are next at 12? (1884.)

16. What is meant in arithmetical language by *factor*, *power*, *numeration*, *prime* and *composite numbers*, *greatest common measure*, *root*, *ratio*? Give examples. (1885.)

17. Express in words the arithmetical truths embodied in these formulæ:

If a be greater than b, then $\frac{a+1}{b+1}$ is less than $\frac{a}{b}$, but if a be less than b, then $\frac{a+1}{b+1}$ is greater than $\frac{a}{b}$, but less than $\frac{a-1}{b-1}$, and give a numerical demonstration. (1886.)

18. Find the square root of 24·950025, and explain, by reference to the principle of involution, the reasons of the employed process. (1887.)

19. The area of an oblong field, whose length is twice its breadth, is 80 acres. Find the length of its sides. (1888.)

20. A rectangular stone basin, the bottom and sides of which are composed of slabs 3 ins. thick, measures externally 8 ft. in length, 2 ft. 6 ins. in breadth and 3 ft. in height. How many gallons will it contain if a gallon occupy ·16 cubic ft.? (1889.)

SELECTED GOVERNMENT QUESTIONS ON HISTORY FOR SECOND SATURDAY.

Males and *Females.*

1. Describe fully one of Marlborough's campaigns. (1882.)

2. Relate the causes of the war with Holland under the Protectorate, the chief events of the war, and the terms of peace. (1883.)

3. Trace the descent of Lady Jane Grey, Lord Darnley, and Lady Arabella Stuart from Henry VII. (1884.)

4. Give the substance of the Petition of Right. How was it received by the king? (1885.)

5. What was the population of England at the time of the Restoration? What were the most important towns at this period, and how was communication maintained between them? (1886.)

6. Name six of the principal English writers who lived in the Stuart period, and mention in the case of each author one or two of the books he wrote. (1887.)

7. When and under what provisions was Scotland united to England? State the character of English legislation in Ireland during the reign of Queen Anne. (1888.)

8. For what events are the following dates memorable:—1604, 1605, 1637, 1644, 1645, 1658, 1678, and 'the 3rd of September'? (1889.)

ROUTINE FOR JULY (MALES)

ROUTINE FOR JULY (MALES).

DAY	FIRST WEEK				SECOND WEEK				THIRD WEEK				FOURTH WEEK			
MONDAY	Algebra. — Revision	History. — Dates from 1461 to 1602 Tudor Dynasty	School Management. — Revise Organisation		Algebra. — Theory of Indices	History. — Outlines from 1685 to 1714	School Management. — Notes of a Lesson on 'The Cabinet System'		Algebra. — Surds	History. — Outlines from 1714 to 1748	School Management. — The Will and its Training, pp. 78—90, Coupland		Algebra. — Government Questions (See Article)	History. — Revision	School Management. — Dislocations, Fractures, Exercise, pp. 249—259, pp. 278—286, Carpenter	
TUESDAY	Euclid. — Revise Book III.	Map. — Irish Sea	English. — Paraphrase Lines 86—105, Scene 3, Act II., Richard II.		Euclid. — First 161 Deductions of Egan, Part II.	Map. — Queensland	English. — Paraphrase 'When a traveller returneth home, let him not leave . . . .' to end of Essay. Bacon's Essays, No. XVIII.		Euclid. — Axioms, Postulates, Definitions of first 6 books. Terms employed	Maps. — Ceylon. Coast line of India	English. — Paraphrase Lines 773—790 Lancelot and Elaine		Euclid. — First 191 Deductions of Egan, Part II.	Geography. — Shape and size of the earth	English. — Paraphrase Lines 4—26, Scene 2, Act III., Richard II.	
WEDNESDAY	Arithmetic. — Miscellaneous (See article.)	English. — Write 20 lines of Composition on Lines 14 and 15 of Scene 2, Act. II., Richard II.	Euclid. — Revise any Deductions		Arithmetic. — Peculiar Proportions	English. — Write 20 Lines of Composition on 'International disputes'	Euclid. — Definitions of First 5 Books		Arithmetic. — Stocks	Algebra. — The theory of Quadratics	Euclid. — Revise deductions on Books I. and II.		Arithmetic. — Solid Content	English. — Richard II. to end of Scene 3, Act I.	Euclid. — First 14 Propositions of Book VI.	
THURSDAY	School Management. — To end of p. 47, Jevon's Logic Primer	Geography. — Our North American Possessions	English. — Study Matter of Richard II.		School Management. — Spencer on Education. (See Article thereon)	Geography. — West Indies	English. — First 240 lines of Lancelot and Elaine		School Management. — Notes of a Writing Lesson to Standard VII.	Geography. — British North America	English. — Richard II. to end of Scene 2, Act I.		School Management. — Spencer on Education (See Article thereon)	Geography. — Flora and Fauna of the Temperate Zones	English. — Lines 240—463 of Lancelot and Elaine	
FRIDAY	Algebra. — Quadratic Equations	History. — Reign of Elizabeth, pp. 103 to 120, Davies	Writing. — 1 Dictation 2 Copy Book 3 Word or passage previously set		Algebra. — Surds	History. — Literature, pp. 207 to 220, Davies	Arithmetic. — Areas		Algebra. — Ratio and Proportion	History. — Reign of Elizabeth, pp. 120 to 131, Davies	Geography. — Possessions in South America		English. — Write 20 lines of Composition upon 'The Spanish Armada'	History. — Revise	English. — 1 Place of Bacon among English Authors. 2 His chief works 3 His style	
SATURDAY	Euclid. — Revise Book IV.	English. — Bacon's Essays, 5, 9, 11 and 14	School Management. — Ventilation (To end of p. 86 of Carpenter's Hygiene)	Geography. — Tides	Euclid. — First 176 Deductions of Egan, Part II.	Examination — History (See Article)	School Management. — Half-Time Registration. Revision		Euclid. — First 7 Propositions of Book VI.	English. — Bacon's Essays, 15—18	Geography. — Flora and Fauna of the Arctic and Antarctic Regions	Algebra. — Government Questions. (See Article)	History. — Lives of Great Men, pp. 180—187, Davies	Examination — Arithmetic (See Article)	English. — Lines 463—700 of Lancelot and Elaine	

ROUTINE FOR JULY (FEMALES).

DAY	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
MONDAY	Arithmetic. — Square Root and Fourth Root	History. — Dates 1685 to 1689. Curtis' Date Book	School Management. — Revise Organization	Arithmetic. — Partnership, Capel, p. 203, sums 4 to 10; p. 204, sums 18 to 20	History. — Parliaments of the Commonwealth	School Management. — Notes of a Lesson on 'The Cabinet System'	Arithmetic — Interest	History. — Cromwell's Campaigns in Ireland and Scotland. Battle of Worcester. Plots against Cromwell	School Management. — The Will and its Training, pp. 78 to 90. (Coupland)	Arithmetic. — Net Income from Stocks, allowing for Income Tax, etc.	History. — The Quakers. The Postal System. Religious Toleration (1649 to 1660)	School Management. — Dislocations. Fractures. Exercises. pp. 249 to 259, 278 to 286. Carpenter
TUESDAY	Domestic Economy. — Describe 6 cheap and wholesome dinners for 50 children, stating quantity and cost of material	Geography — Map of British Guiana	English. — Paraphrase Lines 86—105, Scene 3, Act II., Richard II.	Domestic Economy. — How would you diet a patient recovering from pneumonia?	Geography. — Map of Australia	English. — Paraphrase Lines 36—61, Scene 2, Act III., Richard II.	Domestic Economy. — Give list (with cost) of utensils for Cottage Cookery. What sort of stove or range would you prefer? Why?	Geography. — Map of New Zealand	English. — Analyse and Parse difficult words of lines 117—130, Scene 3, Act II., Richard II.	Domestic Economy. — How may a working man's garden be best turned to account as regards home consumption and sale of superfluous produce?	Geography — Australia (Physical)	English. — Paraphrase Lines 4—26, Scene 2, Act III., Richard II.
WEDNESDAY	Arithmetic. — Government Questions. (see Article)	English. — Write 20 Lines of Composition on Lines 14 and 15, Scene 2, Act II., Richard II.	Sewing, etc. — In a Scale Drawing Book, draw the required diagrams	Arithmetic. — Government Questions. (See Article)	English. — Write 20 Lines of Composition on 'International Disputes'	Sewing, etc. — Cut out (on sectional paper) and tack together half of the upper portion of a muslin pinafore	Arithmetic — Government Questions. (See Article)	Sewing, etc. — Practise Stocking web and a print patch	Domestic Economy. — What puddings are suitable for sick persons? Describe the making of three kinds	Arithmetic — Stocks	Sewing, etc. — In a Scale Drawing Book, draw the required diagrams	Domestic Economy. — State the Post Office facilities for saving, purchasing annuities, and investments in general
THURSDAY	School Management. — To end of p. 47 Jevon's Logic Primer	Geography. — Hindostan	English. — Richard II. Date and composition. Sources of Plot. Historical Personages	School Management. — Spencer on Education. (See Article thereon)	Geography. — Bermudas. Honduras	English. — Analyse and Parse difficult words of lines 104—117, Scene 2, Act III., Richard II.	School Management. — Notes of a Writing Lesson to Standard VII.	Geography. — West Indies	English. — Notes and text of Richard II. to end of Scene 4, Act I.	School Management. — Spencer on Education. (See Article thereon)	Geography. — Revise	English. — Richard II. Characters of the 'Dramatis Personæ'
FRIDAY	Arithmetic. — Fractions	History. — Literature, etc., Davies, pp. 116 & 117, and revision. (See Article)	Writing. — 1. Dictation. 2. Copy Book, 3. Copy previously set.	Arithmetic. — Prove by examples the rules for G.C.M. and L.C.M.	History. — Navigation Act, 1651. Westminster Confession of Faith	Sewing, etc. — Describe the different methods of patching. Which do you prefer? Why?	Arithmetic — Insurance and Percentages	History. — War with Holland and Spain, coercion of Tuscany, Algiers, Tripoli, Tunis, and Rome (1649 to 1660)	Any backward work	English — Write short lives of— 1. Newton, 2. Laud, and 3. Ireton	History. — Dates 1603 to 1624 Curtis' Date Book	Sewing, etc. — Practise the different darns as before, and darning as for 'Hedge Tear'
SATURDAY	Domestic Economy. — How should a beef steak, a sole, and a pig's heart, be cooked? How would you make batter, bread, and rice puddings?	English. — Trench, Lecture I.	School Management. — Ventilation, To end of p. 86 of Carpenter's Hygiene	Geography — Canada	Sewing, etc. — Practise grafting, Swiss-darning, running darn as for heel	Examination — History (see Article)	School Management. — Half-Time Registration (Revision)	Domestic Economy. — What habits should a lone schoolmistress cultivate to avoid corporeal and mental infirmity and irritability?	English. — Richard II., Notes on the Language of the Play	Geography — West Indies	Sewing, etc. — Practise any cutting out wherein you are deficient	History, Literature, etc. — Davies, pp. 118 to 125 (see Article)	Examination — Arithmetic (see Article)	English. — Trench, Half of Lecture II.

SELECTED GOVERNMENT QUESTIONS IN ALGEBRA FOR THIRD SATURDAY AND FOURTH MONDAY.

1. Resolve $x^2 - 3x - 130$; $x^4 - 81$; $a^2(b-c) + b^2(c-a) + c^2(a-b)$ into elementary factors. (1889.)

2. Divide $6x^{\frac{3}{4}} - 96x^{-\frac{3}{4}}$ by $x^{\frac{1}{4}} - 2x^{-\frac{1}{4}}$. (1888.)

3. A number is divided into three parts, such that one-third of the number exceeds the first part as much as the second part exceeds one-fourth of the number. Find the third part. (1887.)

4. If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f}$, prove that each of these fractions is equal to $\frac{ma + nc + pe}{mb + nd + pf}$ (1886.)

5. The equations

$$2x^3 + 21x^2 + 34x - 105 = 0$$
$$2x^3 - x^2 - 76x - 105 = 0$$

have one root in common; find the other two roots. (1885.)

6. Show that $\frac{(x-b)(x-c)}{(a-b)(a-c)} + \frac{(x-c)(x-a)}{(b-c)(b-a)} + \frac{(x-a)(x-b)}{(c-a)(c-b)} = 1$. (1848.)

7. Prove that in taking the square root of a number when $n+1$ digits in the root have been obtained by the ordinary rule, n more digits may be obtained by simple division, if the number contain $2n+1$ digit. (1883.)

Illustrate by extracting the sq. root of 2 to five decimal places.

8. Solve the equation

$$\sqrt{x(3-x)} = \sqrt{x+1} + \sqrt{2(x-1)}. \quad (1882.)$$

SELECTED GOVERNMENT QUESTIONS IN ARITHMETIC FOR FOURTH SATURDAY.

Males.

1. Find the cube root of $1277289\frac{1}{8}$. (1889.)

2. A cargo was bought for £10,282, payable 12 months hence, and was immediately sold again for £10,712, payable 8 months hence. What was the gain per cent. *on the value* of the purchase money, discount being at 6 per cent. per annum? (1888.)

3. A watch which is set correctly at noon indicates 10 minutes after 9 the same evening, when the true time is 10. What is the true time when the watch indicates 11 on the same evening? (1887.)

4. By what fraction of an inch should a mountain $4\frac{1}{2}$ miles high be represented on a globe 18 inches in diameter, assuming the diameter of the earth to be 7,900 miles? (1886.)

5. A man buys two horses, A and B; A costs £25 more than B; he sells A at a profit of 15 per cent., and B at a profit of 8 per cent.; his total gain is £37 6s.; what was the original price of each horse? (1885.)

6. The Three per Cents. are at $101\frac{1}{2}$; find the loss or gain in capital and in income which would arise by transferring £10,000 from the Three per Cents. to a $2\frac{1}{2}$ per cent. stock at 108. (1884.)

7. A put into a partnership £4,815 for 1 year and 5 monthe; B put in £3,531 for 2 years and 1 month; C put in £6,099 for 10 months. Their profit was £1,926. What was the share of the profit of each? (1883.)

8. Simplify $2\cdot\dot{0}\dot{9} \times 1\cdot\dot{1}3\dot{5} \times 1\cdot\dot{3}7\dot{6} \times 2\cdot\dot{0}76923 \times 1\cdot\frac{1}{3}71428$.

CORRESPONDENCE.

1. *We shall be pleased to reply briefly and through this column to any seeking information or advice. Endorse* 'CERTIFICATE EDITOR' *if the office be communicated with.*

2. *Replies demanding urgency will be promptly forwarded per post on receipt of stamped and directed envelope. This privilege does not extend to furnishing solutions and answers to examination questions. A post will be saved by addressing direct to Macclesfield.*

3. *Any suggestion tending to the greater utility and interest of these articles, or to the greater convenience of* 'COACH' *or* PUPIL, *will be thankfully received and thoughtfully considered.*

J. P. C. (Crewe), T. R. W. (Congleton), M. C. (Ironbridge), J. C. (Sherrington), CHARITY (Axminster), TOBY (Luton), F. R. T. (Sedbergh), M. N. (Troutbeck), S. T. (Garndiffaith), M. AND F. (Paternoster Row), S. F. L. (Stockton), F. R. (Patricroft), J. L. (Budleigh), E. S. (Macclesfield), T. T. (Stocksfield), YOU ARE (Brentford), M. S. C. (Churwell), TABAC (Belfast), L. H. (Burnley), M. T. P. (Burslem), HOUGH (Bilston), A. B. K. (Bow Road), M. (Wakefield), W. R. (Stockton), CYM (Merthyr), H. R. B. (Somerton), SEN. (Northampton), W. (S. Neots), W. S. (Penge), J. F. T. (Stocksfield), C. D. (Landport), answered by ordinary letter.

J. M. (Boston): Go in and win; CASH (Bodmin): Nevertheless, get the books; O. P. (Winchester): We are glad you are beginning so early; MAV (Reading): It shall be attended to, it has furnished a hint; JOHN (Lewes): (*a*) We cannot undertake to solve problems, try the Query Editor—(*b*) apply to some neighbouring teacher; E. M. (Dartford): See our opening remarks; WHEN (Dunstable): Mr. Heller is the proper person to address; I. O. (Ayr): The Grammar you speak of is simply antediluvian; PUZZLED (Canton): See answer to 'John;' J. N. E. (Hull): A great philosopher and litterateur still living; M. R. (Brixton): A third division in Second Year Papers is 2nd class; COMPEER (South Shields): The papers forwarded are very good indeed. We have not space to particularise; U. S.: See answer to 'I. O.' The statement is incorrect.

(To be continued.)

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Model Answers to Pupil Teacher Examination Papers.

19TH APRIL, 1890.

END OF SECOND YEAR.

SECOND PAPER.

(Two hours and a half allowed.)

Needlework.

(One hour allowed for this exercise.)

GIRLS ONLY.

Make up your piece of calico (9 × 9) in the form of a child's potticoat. Fix a hem and tucks round the bottom, and (if time permits) hem and run them.

Arithmetic.

BOYS ONLY.

(Answer three questions only, including the last if you can.)

1. How many horses will be required to plough 468 acres in 39 days, if 26 horses plough 576 acres in 24 days?

2. In what time will £78 6s. 8d. amount to £83 9s. $5\frac{3}{4}$d. at $3\frac{3}{4}$ per cent. per annum, simple interest?

3. If $5\frac{1}{2}$ per cent. is lost by selling goods for £39 12s. 9d., for what must they be sold to gain 5 per cent?

4. What sum must be invested in a four per cent. Spanish stock at $63\frac{1}{2}$ to give an income of £340 4s. 8d.? (Neglect brokerage.)

Explain the terms *brokerage, average, amount, percentage.*

(1) acres 576 : 468 :: horses 26 : horses x
days 39 : 24
13
2 156

$$x = \frac{26 \times 468 \times 24}{39 \times 576}$$

3 24
12

$= \underline{13 \text{ horses.}}$ Ans.

(2) £83 9s. 5½d. − £78 6s. 8d. = £5 2s. 9½d.
= £5 $\frac{9}{32}$

	£	£	yr.	yr.
Princ.	$78\frac{1}{2}$	100 ::	1 :	x
Int.	$3\frac{9}{32}$	$5\frac{9}{32}$		

$$x = \frac{3}{235} \times \frac{4}{15} \times \frac{100}{1} \times \frac{329}{64}$$

$$= \frac{329}{141} \text{ yrs.}$$

$$= 1\tfrac{188}{141} \text{ yrs.} \quad \text{Ans.}$$

(3) Selling price when there is loss = 94½.
" " gain = 105.

94½	105 ::	£39$\frac{11}{16}$	:	x

$$x = \frac{2}{189} \times \frac{105}{1} \times \frac{3171}{80}$$

$$= \frac{1057}{8}$$

$$= £44\ 0s.\ 10d. \quad \text{Ans.}$$

(4) £63½ will yield £4. Therefore

As £4	: £340$\frac{7}{8}$	::	£63½	: x

$$x = \frac{1}{4} \times \frac{1023}{32} \times \frac{127}{2}$$

$$= \frac{130943}{256}$$

$$= £540\ 1s.\ 1d. \quad \text{Ans.}$$

Brokerage is the percentage charged by a broker for buying or selling shares or stock.

Average is the quotient obtained by dividing the sum of any quantities by the number of the quantities. It is also called the *mean* of the quantities.

Amount is the principal and interest added together.

Percentage is the rate per hundred.

History.

BOYS AND GIRLS.

(*Answer three of these questions.*)

1. With what objects were the Crusades undertaken? What share did any of our English princes bear in them?

2. Name six of the most remarkable female characters in the history of England before the reign of Elizabeth. Give as full an account as you can of any two of them.

3. "Some have been deposed, some sleeping killed." How are these words applicable to any of the Sovereigns of England? Give as full particulars as you can of each event.

4. How do Scotch affairs enter into the history of the reigns of Stephen, Edward I., and Henry VIII.?

5. Give, with dates, the chief events of the reign of Elizabeth.

(1) In 1076 the Turks came into possession of Palestine, and Christain Pilgrims were exposed to great insult, robbery and extortion. To drive the Turks from Palestine and thus to recover the holy places in that country was the work of the Crusades.

Robert, Duke of Normandy joined the second Crusade, 1099.

Richard the First joined the third Crusade, 1190, and assisted in the siege of Acre, returning in 1194.

In 1270 Edward I., previous to his accession to the throne, sailed to Acre, and took Nazareth, after defeating the Saracens in several battles.

(2) Among the famous women of English history were—Boadicea, queen of the Iceni; Matilda, daughter of Henry I.; Eleanor, wife of Edward I.; Phillippa, wife of Edward III.; Margaret of Aujon, the wife of Henry VI.; Queen Mary I. of England.

Boadicea was queen of the Iceni, one of the British tribes. Being deprived of her whole possessions by the Romans, she roused the indignation of her people by relating her wrongs to them, and succeeded in defeating a large Roman force. Being in danger of overthrow, she poisoned herself 61 A.D.

Margaret of Aujon carried on the greater part of the Wars of the Roses on behalf of her husband Henry VI., and after his death on behalf her son. She died in 1482.

(3) *Edward II.* was deposed. He placed the kingdom in the hands of favourites, and the barons on two occasions revolted. Mortimer, Earl of March, assisted by Queen Isabella, pursued Edward towards Wales. His favourites were defeated, and he fled, but was captured near Neath. Parliament then deposed him, and he was confined successively in Corfe and Berkeley Castles, in the latter of which he was murdered.

Richard II. was deposed. His government was bad, owing to his love of favourites. He banished his cousin Hereford, who returned on the death of his father. Richard was made a prisoner, sent to London, and deposed by the parliament. (1399.)

Edward IV. was driven from the kingdom in 1470, and *Henry VI.*, who had been deposed in 1461, was for a time restored.

Edward V. was first deposed and then murdered whilst sleeping in the Tower. (1483.)

(4) David, King of Scotland, assisted Matilda. He reduced Carlisle, Alnwick, and Newcastle, but made a treaty with Stephen at Durham (1136). In 1138 David renewed the war, making several inroads into the country, and treating the people with great barbarity. On the third occasion, under the leadership of the Bishop of Durham, the battle of the Standard was fought and 12,000 Scots lost their lives. During the remainder of Stephen's reign the Scots held Northumbria.

Edward I. arbitrated on the claims of Baliol and Bruce to the Scottish throne (1292), claiming lordship himself. Baliol revolted. Siege of Berwick, battle of Dunbar, and total subjugation of Scotland followed. Then came the war of Scottish independence (1297—1304). Bruce revolted in 1305. Edward's march upon Scotland was cut short by his death.

James IV. of Scotland, to assist the French against Henry VIII., invaded England, but was killed at Flodden Field with 10,000 of the soldiers and nobility of Scotland. (1513.)

In 1523 the Earl of Surrey burnt Jedburgh and devastated South Scotland to prevent the Scots assisting Francis again.

(5)

Accession of Elizabeth	A.D.	1558
Spiritual supremacy of the Crown re-established		1559
Rise of the Puritans		1566
Excommunication of Elizabeth		1570
Mary Queen of Scots in England ...		1568—1587
Duke of Norfolk executed for plotting against the Queen		1571
Founding of Virginia		1574
Babington and other conspirators beheaded ...		1586
Execution of Mary Queen of Scots		1587
Spanish Armada		1588
Rebellion in Ireland		1598—1601
East India Company incorporated		1600
Poor Law Statutes passed		1601

Teaching.

BOYS AND GIRLS.

(*Answer two questions only.*)

1. Arrange the letters of the alphabet in the order of their difficulty for the teaching of writing; and show how you would group together the easiest of them for lessons to young beginners.

2. Say what sort of reading lessons you have found most interesting to young children; and describe the way in which you would try to secure distinct articulation.

3. Say how you would explain to beginners the rule for subtraction, and illustrate your answer by this example:—

806 − 527

(1.) The letters of the alphabet should be grouped according to their method of construction. Nearly all the small letters consist of the following elements / ∪) ∩ ∫ ○ and their combinations. Teach first these forms, then the simplest combinations of them, and then the more difficult.

GROUP I. *i u w m n*

GROUP II. *t l b h p*

GROUP III. *a a d j g*

GROUP IV. *y v g r*

GROUP V. *e f h*

GROUP VI. *c s x z*

The capital letters follow the same rule, but the groups are not necessarily the same. The easiest of the above letters should be taken first as *it, ul, mu, nt,* and so on.

(2) Reading lessons consisting of little stories of everyday life which the children can understand, or which they themselves might participate in, are the most interesting. Tales of clever animals are also very much liked, whilst the quicker children enjoy stories which contain some joke or funny incident.

To get distinct articulation, I require the children to imitate me in the pronunciation of all the letters, to open the mouth freely, to speak up, and to read slowly. Exercises are often given on the use of the lips, tongue, and teeth in speaking. Common mistakes, such as talking with the teeth closed, mumbling, &c. are always corrected.

(3) There are two methods for teaching subtraction, both of which are difficult for little children to understand. I give frequent practice in notation and numeration, showing the *values* of the figures, one of the tens figures being equal to ten of the units, and one of the hundreds being equal to ten of the tens figures. Difficulty is experienced when there is a 0 in either of the places in the minuend or top line, because a double borrowing has to take place.

$\begin{array}{r} {}^{7}{}_{8}{}^{9}{}_{0}{}^{16}6 \\ 5\,2\,7 \\ \hline 2\,7\,9 \end{array}$ We cannot take 7 from 6, so we borrow 1 from the tens figure and put it to the side of the six, this makes the 6 into 16. But there is no 1 in the tens place, so we borrow one from the hundreds place. Take one ten away from it, it will leave nine tens, and the one from the hundreds leaves 7 hundreds. We can now take 7 units from 16 units, leaves 9 units; 2 tens from 9 tens leaves 7 tens, and 5 hundreds from 7 hundreds leaves 2 hundreds.

Mensuration.

BOYS ONLY.

(*Answer one question only*).

1. A ladder 41 feet long stands upright against a wall. How far will the top fall by drawing out the bottom 9 feet?

2. Two opposite sides of a field are parallel: their lengths are respectively 10 chains 30 links and 7 chains 70 links, and the distance between them is 7 chains 50 links: find the acreage.

(1) $\sqrt{41^2 - 9^2}$
$= \sqrt{1681 - 81}$
$= \sqrt{1600}$
$= 40$ the height of wall to top of ladder;
$\therefore$ ladder falls *one foot*. Ans.

(2) 10 ch. 30 l. + 7 ch. 70 l. ÷ 2
$= 18 \div 2 = 9$ chains
$\therefore$ Area = 7 ch. 50 l. × 9 ch.
$= 67\frac{1}{2}$ sq. ch.
$= 6\frac{3}{4}$ acres. Ans.

(*Three hours and a half allowed.*)

Euclid.

BOYS ONLY.

[All generally understood abbreviations and symbols for *words* may be used, but not symbols of operation, such as −, +, ×.]

(*Answer two questions, including Question* 3, *if you can do so.*)

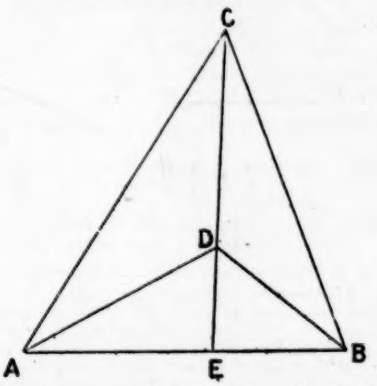
1. If a straight line, falling on two other straight lines, make the alternate angles equal to one another, these two straight lines shall be parallel.

Euclid, Book I., Prop.

2. Parallelograms on the same base, and between the same parallels, are equal to one another.

Euclid, Book I., Prop.

3. The angle contained by the bisectors of the angles at the base of any triangle is equal to the vertical angle together with half the sum of the base angles.



Let ABC be any triangle, and let the ∠'s BAC, ABC be bisected by the straight lines AD and BD meeting in D. Join CD and produce CD to meet AB in E. Then ∠ ADB shall equal ∠ ACB together with half the sum of ∠'s CAB, CBA.

Proof.—∠ADE = ∠'s DAC, ACD (I. 32).
Also ∠ BDE = ∠'s BCD, DBC (I. 32)
$\therefore$ Whole ∠ ADB = whole ∠ ACB together with ∠'s CAD, CBD.
But ∠'s CAD, CBD = $\frac{1}{2}$ ∠'s CAB, CBA (Hyp.)
Therefore, &c. Q.E.D.

Algebra.

BOYS ONLY.

(*Answer three questions, including Questions* 1 *and* 4, *if you can do so*).

1. Prove that $a^m \times a^n = a^{m+n}$, where a, m, n are any positive integers. What is the cost of carpeting a room p feet long, q yards broad, at r shillings per square yard?

2. Find the value of:—

(1.) $\dfrac{2a^2}{a^2 - b^2} - \dfrac{a}{a+b} - \dfrac{b}{a-b}$.

(2.) $\dfrac{4}{2x^2 + 7x - 4} - \dfrac{3}{10x^2 + x - 3}$.

3. Find the square root of $81x^4 - 234x^3 + 367x^2 - 286x + 121$.

4. Solve the equations:—

(1.) $\frac{3}{4}(4x - 9) - \frac{2}{7\frac{1}{2}}(5x - 12) = 6\frac{1}{11}$.

(2.) $\dfrac{3x+1}{4} + \dfrac{x+1}{x+8} = \dfrac{9x+8}{12}$.

(1) $a^m \times a^n = a^{m+n}$.
For $a^m = a \times a \times a \times a \ldots$ to m factors
and $a^n = a \times a \times a \times a \ldots$ to n factors
$\therefore a^m \times a^n = a \times a$ to $m + n$ factors, that is
$a^m \times a^n = a^{m+n}$ factors.
p feet × q yards.
$= \dfrac{p}{3} \times b = \dfrac{pq}{3}$ yds. the area.
cost = $\dfrac{pq}{3} \times r$ shillings
$= \dfrac{pqr}{3}$ shillings. Ans.

(2)

(1) $\frac{2a^2}{a^2-b^2} - \frac{a}{a+b} - \frac{b}{a-b}$

$= \frac{2a^2 - a(a-b) - b(a+b)}{a^2-b^2}$

$= \frac{2a^2 - a^2 + ab - ab - b^2}{a^2-b^2}$

$= \frac{a^2-b^2}{a^2-b^2}$

$= \underline{1}$. Ans.

(2) $\frac{4}{2x^2+7x-4} - \frac{3}{10x^2+x-3}$

$= \frac{4}{(x+4)(2x-1)} - \frac{3}{(5x+3)(2x-1)}$

$= \frac{20x+12-3x-12}{(x+4)(5x+3)(2x-1)}$

$= \frac{17x}{(x+4)(5x+3)(2x-1)}$

$= \underline{\frac{17x}{10x^3+41x^2+x-12}}$. Ans.

(3) $81x^4 - 234x^3 + 367x^2 - 286x + 121 \;(9x^2 - 13x + 11$

$81x^4$

$18x^2 - 13x) \quad -234x^3 + 367x^2$

$-234x^3 + 169x^2$

$18x^2 - 26x + 11) \quad 198x^2 - 286x + 121$

$198x^2 - 286x + 121$

(4)

$\frac{3}{7}(4x-9) - \frac{1}{13}(5x-12) = 6\frac{1}{91}$

L. C. M. $= 91$

$39(4x-9) - 49(5x-12) = 587$

$156x - 351 - 245x + 588 = 587$

$-89x = 350$

$x = -\frac{350}{89}$

$= \underline{-3\frac{83}{89}}$ Ans.

(2)

$\frac{3x+1}{4} + \frac{x+1}{x+8} = \frac{9x+8}{12}$

L. C. M. $= 12(x+8)$

$(3x+1)(3x+24) + 12x + 12 = (9x+8)(x+8)$

$9x^2 + 75x + 24 + 12x + 12 = 9x^2 + 80x + 64$

$7x = 28$

$x = \underline{4}$ Ans.

Arithmetic.

GIRLS ONLY.

(*Answer three questions only, including the last, if you can.*)

1. Simplify the fraction—

$$\left\{\frac{7\frac{1}{2}+5\frac{3}{5}}{7\frac{1}{2}-5\frac{3}{5}} - \frac{7\frac{1}{2}-5\frac{3}{5}}{7\frac{1}{2}+5\frac{3}{5}}\right\} \div 3\frac{3}{7}.$$

2. Find the value of 3·125 of £9 4s. 6d. − ·06 of £17 6s. 3d. + 5·136 of £3 9s. 8d.

3. If 4 cwt. 2 qrs. 15 lbs. of sugar can be bought for £4 6s. 6d., what will be the price of 9 cwt. 3 qrs. 23 lbs.

4. Divide 42·39 by 2·7, ·04239 by 27,000 and 423,900 by ·0027. *Prove* the first sum by working it according to the rule for division of vulgar fractions.

(1) $\left\{\frac{7\frac{1}{2}+5\frac{3}{5}}{7\frac{1}{2}-5\frac{3}{5}} - \frac{7\frac{1}{2}-5\frac{3}{5}}{7\frac{1}{2}+5\frac{3}{5}}\right\} \div 3\frac{3}{7}$

$= \left\{\frac{7\frac{1}{2}+5\frac{3}{5}}{6\frac{1}{2}-5\frac{3}{5}} - \frac{6\frac{1}{2}-5\frac{3}{5}}{7\frac{1}{2}+5\frac{3}{5}}\right\} \div \frac{24}{7}$

$= \left\{\left(13\frac{1}{10} \div 1\frac{7}{10}\right) - \left(1\frac{7}{10} \div 13\frac{1}{10}\right)\right\} \div \frac{24}{7}$

$= \left\{\left(\frac{131}{10} \times \frac{10}{17}\right) - \left(\frac{17}{10} \times \frac{10}{131}\right)\right\} \div \frac{24}{7}$

$= (7 - \frac{1}{7}) \div \frac{24}{7}$

$= \frac{48}{7} \times \frac{7}{24}$

$= \underline{2}$. Ans.

(2) 3·125 of £9 4s. 6d. = 27 13 6

$= 1\ 3\ 0\frac{3}{4}$ 28 16 6¼

5·136 of £3 9s. 8d. $= 5\frac{136}{1000}$ of £3 9 8

$= 5\frac{17}{125}$ of 3 9 8

$= 113 \times 3s.\ 2d.$ 17 17 10

46 14 4¼

·06 of £17 6 3 $= \frac{1}{15}$ of 17 6 3 = 1 3 1

Ans. £45 11 3¼

(3) 4 cwt. 2 qrs. 15 lbs. = 519 lbs.

9 cwt. 3 qrs. 23 lbs. = 1115 lbs.

lbs. lbs. d. d.

519 : 1115 :: 1038 : x

x = 2230d.

= £9 5s. 10d. Ans.

(4) 2·7)42·39(15·7. Ans.

27

153

135

189

189

·04239 ÷ 27000

= ·00004239 ÷ (3 × 9)

= ·00001413 ÷ 9

= ·00000157. Ans.

423900 ÷ ·0027

= 4239000000 ÷ (3 × 9)

= 1413000000 ÷ 9

= 157000000. Ans.

42·39 ÷ 2·7

$= 42\frac{39}{100} \div 2\frac{7}{10}$

$= \frac{4239}{100} \times \frac{10}{27}$

$= \frac{4239}{270}$

$= 15\frac{189}{270}$

$= 15\frac{7}{10}$

$= \underline{15·7}$. Ans.

English Grammar and Composition.

BOYS AND GIRLS.

(*Answer Questions* 1 *and* 2, *and one other only*)

1. Paraphrase this passage :—

Still on the spot Lord Marmion stayed,
For fairer scene he ne'er surveyed,
When, sated with the martial show
That peopled all the plain below,
The wandering eye could o'er it go,
And mark the distant city glow
With gloomy splendour red ;
For on the smoke-wreaths, huge and slow
That round her sable turrets flow,
The morning beams were shed,
And tinged them with a lustre proud
Like that which streaks a thunder-cloud.

2. Analyse the last five lines, and parse the last line.

3. Point out any words in the above extract which you know from their form to be of foreign origin ; and give the meaning of each of such words, and an explanation of its parts.

4. If you see any mistakes in the following sentences correct them and give your reasons.

(*a*) That is the man whom I thought was a hero.
(*b*) Let you and I endeavour to set it right.
(*c*) He is more diligent than me.
(*d*) I differ wholly with the orator on that point.
(*e*) Who are you speaking of ?
(*f*) There let him lay.

5. Explain and illustrate these statements :—

(*a*) Two negatives make an affirmative.
(*b*) Relatives must agree with their antecedents.
(*c*) The infinitive is often equal to a noun.
(*d*) The subject of a sentence may be enlarged by a word, by a phrase, or by another sentence.

(1) Lord Marmion, after having gazed his fill of the army which lay scattered in the valley, still seemed rooted to the spot; for a more glorious scene could not anywhere be found. In the distance the city was wrapped in a blood red splendour, the smoke-wreaths slowly curling upwards from the chimney-tops being tinged with the bright glow of the morning sunbeams, which gave them a majestic radiance like that which marks the clouds during a thunder-storm.

(2) (*a*) For, on the smoke-wreaths, huge and slow, the morning beams were shed.

(Principal sent.)

Connective: for.

Subj.: the morning beams.

Pred.: were shed.

Ext. of pred.: on the smoke-wreaths, huge and slow (place).

(*b*) That round her sable turrets flow.

(Adj. sent. to *smoke-wreaths* in *a*.)

Subj.: that.

Pred.: flow.

Ext. of Pred.: round her sable turrets (place).

(*c*) And tinged them with a lustre proud like that.

(Princ. sent. co-ord. with *a*)

Connective: and.

Subj: [they].

Pred.: tinged.

Obj.: them.

Ext. of Pred.: with a lustre proud like that (manner).

(*d*) Which streaks a thunder-cloud.

Subj.: which.

Pred.: streaks.

Obj.: a thundercloud.

Like—adj. gov. *lustre*.

that—distinguishing adj., limiting *lustre*.

which—pro. rel., neut., sing., 3rd., nom. to *streaks*.

streaks—verb, reg., trans., act., indic., pres., 3rd. sing., agreeing with its nom. *which*.

a—distinguishing adj., pointing out *thunder-cloud*.

thunder-cloud—comp. com. noun, neut., sing., 3rd, obj. gov. by *streaks*.

(3) *scene*—from Lat. *scena*, a view, through Fr. scène.

surveyed—from Lat. *super*, above, or over, and *video*, to see. *ed*, affix forming the past tense. Through Fr. *surveoir*, gazed upon.

martial—from Lat. *Mars*, and *al*, of or belonging to, warlike.

distant. from Lat. *dis*, *di*, apart, and *sto*, to stand, afar off.

splendour—from Lat. *splendeo*, to shine, and affix *our*, forming abstract noun; grandeur.

sable—from Fr., *sable*, black.

turrets—from Fr. *tourelle*, *tourette*, a tower, *s*, the plural formation.

lustre—from Ital. through Fr., *lustro*, to shine; brightness.

(4) (*a*) *Whom* should be who, because the word is nominative to *was*.

(*b*) *I* should be *me*, the transitive verb *let* requiring an objective case after it.

(*c*) *Me* should be *I*. Than is a conjunction and the word which follows is subject (nom. case) to 'am much diligent.'

(*d*) *With* should be *from*. The meaning of the word differ requires *from* as the preposition to follow it.

(*e*) *Who* should be *whom*. The word should be the objective case after the preposition *of*.

(*f*) *Lay* should be *lie*. Lay means *to deposit*. The word required is the word which means to recline now, that is, lie.

(5) (*a*) The first negative denies the second negative; thus, He does not live nowhere. If he does not live nowhere, he must live somewhere; the two negatives thus make an affirmative.

(*b*) The relative pronoun stands for a noun to which it carries back the mind. If the noun is masculine gender, the pronoun is the same, if plural number the relative is the same. They agree also in person. Thus, This is the man of whom I spoke.

Whom is masc. gen., sing. no., and 3rd per., like man its antecedent.

(*c*) We can use the infinitive in place of the noun; thus, *Reading is pleasant* may be changed to, *To read is pleasant*, where *To read* is like a noun and is nom. to *is*.

(*d*) The simple subject of a verb is a noun or pronoun in the nom. case. But it may be enlarged; thus, Good wine needs no bush, where the word *good* is used to enlarge the subj.—The man throwing himself forward was instantly killed, where the *phrase* throwing himself forward is used to describe the subj. *man*—The man that stayed here is an artist, where the sentence that stayed here is used to describe the subj. man.

Geography.

(*Answer three questions only.*)

1. Draw a map of

(*a*) The Chinese Empire;

or (*b*) The course of the Nile;

or (*c*) The lake system of Central Africa.

2. What are the principal additions to our knowledge of the geography of Equatorial Africa recently made by Stanley?

3. Give a full account of the Persian Empire, the states by which it is bounded, the chief industries, the religion of its people.

4. Where are Ispahan, Souakim, Smyrna, Agra, Merv, Tokio Hong Kong, Mombassa, and Timbuctoo?

5. Explain the terms Monsoon, great Polar current, and explain why, in summer, a sea-breeze springs up at the sea-side in the morning and dies away in the afternoon.

2. Mr. Stanley has passed through the middle of Africa from east to west, and in his last expedition from west to east. He has traversed the whole course of the River Congo and been the means of establishing the Congo Free State. He has accurately defined the positions of the Albert Nyanza, Albert Edward Nyanza, and the Victoria Nyanza, showing that the true source of the Nile is the most southerly feeder of the Albert Edward Nyanza, a lake round the whole of which he has travelled. He has more accurately surveyed the Victoria Nyanza, showing that it has a south-easterly extension not before known. The position of the Mountains of the Moon has also been defined, and the nature of the whole of the interior of the country, and the character of the inhabitants, the resources of various states, and the prospects for British commerce, have been accurately pourtrayed.

3. Persia is an empire under a despotic ruler in the south of Asia, being bounded on the north by Russia, the Caspian Sea and West Turkestan, on the east by Afghanistan and Beloochistan, on the south by the Arabian Sea and the Persian Gulf, and on the west by Turkish Arabia. It is about 700 miles long by 900 miles broad, and consists of a great table land in the west and south, with a great plain of arid, sandy deserts and salt lakes and wastes to the north and east. A great part of the west and north-west, between the Caspian and Elburz Mountains, is very fertile and produces all kinds of fruit in great abundance, as well as wheat, barley, and millet. Roses are extremely plentiful, and the vine, orange, mulberry, cotton plant, and the sugar-cane are common objects of cultivation. The people manufacture silk and cotton-fabrics, gold and silver brocade, carpets, leather, jewellery and shawls of goats and camels' hair. They are a lively, active, polite, and intelligent people. Their established religion is Mohammedanism; but there are many Jews and Christians, and about 10,000 Parsees, who continue to worship the sun and moon and fire as emblems of the god Ormund. The government is despotic, but the nomadic tribes are almost independent. The chief towns are Teheran the capital, Ispahan, Bushire, Balfroosh, Meshed, and Astrabad.

4. *Ispahan*, the ancient capital of Persia, situated some distance north of the Persian Gulf in the province of Irak-Ajemi.

Souakim, in Nubia, on an island situated about midway in the Red Sea, with a good harbour.

Smyrna, on a gulf of the same name in the archipelago, a seaport and ancient city of Asia Minor.

Agra, on the right bank of the Jumna, in the province of Agra, north-west provinces of India.

Merv, an ancient town in West Turkestan on the river Murghab.

Tokio, on a splendid bay on the east-coast of the island of Niphon, the largest Japanese island.

Hong Kong, a small island belonging to Britain near the mouth of the Canton River, south east of China.

Mombassa, a seaport on the east-coast of Zanzibar and north of the island of Zanzibar, East Africa.

Timbuctoo, a little to the north of the great bend of the river Niger, and one of the chief caravan stations of the Sahara and Northern Soudan.

5. The *Monsoons* are the modified trade winds of the Indian and Pacific Oceans, blowing from the north-east and south-west from October to April, and April to October respectively.

The great *Polar Current* is a strong Arctic current which flows southward along the east-coast of Greenland and joins the current from Davis' Strait. At first it is a surface current, but descends, and flows below the Gulf Stream.

The land receives and parts with heat more readily than the water. Consequently in the morning after the sun has heated the land, the air above it becomes warmer and lighter than that over the sea, which then blows towards the land to restore the equilibrium. Towards the afternoon the air over both sea and land is almost of the same temperature, and thus the breeze dies away.

Penmanship.

BOYS AND GIRLS.

Write in large hand the word *Gamopetalous*, and in small hand *Sweet sleep that makes more short the night.*

SECOND PAPER.

(Two hours and a half allowed.)

Needlework.

GIRLS ONLY.

(One hour allowed for this exercise.)

Make up your piece of print (6 × 6) as parts of the back widths of a child's frock body. Sew on a button and make a button-hole.

Arithmetic.

BOYS ONLY.

(Answer three questions only, including the last, if you can.)

1. Find the difference between the interest on £133 6s. 8d. for 6 months at 4½ per cent. per annum, and the discount on £83 due 15 months hence at 3 per cent. per annum.

2. Find the ratio of 23½ of 7 tons 2 cwt. 1 qr. 9½ lbs. to 21 tons 7 cwt.

3. Find the number of feet in $\frac{3}{10}$ of a mile + $\frac{5}{11}$ of a furlong − $5\frac{11}{15}$ poles.

4. Explain the rule for finding the square root of a number of four digits by an algebraical illustration. Find the square root of $424\frac{9}{11}$.

1. The interest for 6 mos. at 4½ % = 2¼ % per ann.

$$\frac{£133\ 6s.\ 8d. \times 2\frac{1}{4}}{100} = 1\frac{1}{3} \times 2\frac{1}{4} = £3.$$

£100 in 15 mos. at 3 % would produce £3¾

∴ Discount = £103¾ : 83 :: 3¾ : x

$$x = \frac{415}{4} \times \frac{83}{415} \times \frac{15}{4}$$
$$= \frac{249}{16}$$
$$= £3\frac{1}{16}$$

Diff. = £3¾ − £3 1/16
= £2 15/16
= 12s. 6d. Ans.

2. 23½ × 7 tons 2 cwt. 1 qr. 9½ lbs.
$= \frac{47}{2} \times \frac{313}{14}$
$= \frac{14711}{28}$ lbs.

21 tons 7 cwt. = 47824 lbs.

Ratio = $\frac{14711}{28}$: 47824
= 3347680 : 430416
= 70 : 9

ft.

$$\frac{3}{30}m = \frac{3 \times 5280}{30}\text{ ft.} = 528$$

$$\frac{8}{21}f = \frac{8 \times 660}{21}\text{ ft.} = 251\frac{3}{7}$$
$$779\frac{3}{7}.$$

$$-5\frac{77}{165}p = \frac{202 \times 33}{35 \times 2} = 95\frac{5}{35}$$
$$684\frac{1}{5}.\ \text{Ans.}$$

(4) The square of the sum of two numbers equals the sum of their squares plus twice their product, as—

$$(a + b)^2 = a^2 + 2ab + b^2$$

Since 10 × 10 = 100 and 100 × 100 = 10,000, it follows that any number of four digits only is the square of some number less than 100. If, therefore, we have a number of four digits which is the square of any number, then that number will be above 10 and less than 100, that is, the root will be of two digits.

Extract the square root of 4096.

Since there is a root figure for every two figures in the square, this number will be divided into two periods. Point thus: 4096. Find the nearest root of 40: this is 6. As it is for the second period this will be 60. $60^2 = 3600$. $4096 - 3600 = 496$. This contains *twice* 60 × the units' figure and the square of that figure. Twice 60 = 120 and 496 ÷ 120 = 4. Then 120 × 4 = 480, and 496 − 480 = 16 which is the square of 4. Hence the square root of 4096 is 60 + 4, and in this case,

$$a^2 + 2ab + b^2 = 60^2 + 2.\ 60.\ 4 + 4^2$$
$$424\frac{9}{11} = \frac{10009}{11}$$
$$\sqrt{\frac{10009}{11}} = \frac{103}{3}$$
$$= 20\frac{2}{3}.\ \text{Ans.}$$

History.

BOYS AND GIRLS.

(Answer three questions only.)

1. What were the main causes which disposed the nation to receive Charles II. and William III. respectively as its sovereign?

2. The war of the Spanish Succession, the Crimean War, the Peninsular War, the Seven Years' War. Say what you can about the origin and the results of any two of these.

3. The reign of Anne is famous for its literary talent. Name the chief political writers, essayists, or poets of the period, and name as many as you can of their principal works.

4. Give briefly an account of the establishment of our first settlements in America and Australia. What famous names are connected with the events you have named?

5. Write a short life of the first Duke of Wellington.

1. The disturbances which took place immediately after the death of Cromwell made the people greatly fear the outbreak of another civil war between the rival generals. In addition to this fact, the reaction against the austerity of the puritanical rule of the previous eleven years set in with great force, and these two feelings combined made the people agree readily to the return of Charles II.

James II's attempt to re-establish Roman Catholicism and the possibility of its success, rendered still more likely after the birth of an heir, was the main cause of his deposition and the disposition to receive William III.

2. William III. and Louis had agreed upon a scheme for disposing of the dominions of Charles II. of Spain on his decease, their conclusions being embodied in the Partition treaties. On his death, however, it was found that the whole of the monarchy had been willed to Philip of Anjou, Louis's grandson. On behalf of the Archduke of Austria, therefore, an alliance including England, Austria, Holland, Portugal, and Savoy, was formed. War lasted from 1702 till 1713, during which Marlborough won many victories. The treaty of Utrecht was signed in the latter year. The chief clauses of this peace provided for a recognition of the Protestant succession of the House of Hanover, and the cession of Newfoundland, St. Christopher, Hudson's Bay, and Novia Scotia to the English by the French. Spain also gave up to her Minorca and Gibraltar, while the Emperor got Naples, Milan, Sardinia, and the Spanish Netherlands.

War between England and France existed from 1793 to 1815, with but a short interval of peace. During that time several naval engagements and numerous land battles were fought. That part of the war known as the Peninsular War took place from 1808 to 1813. In 1808 Napoleon displaced Ferdinand of Spain, and placed his own brother Joseph on the throne. Spain disliked this, declared war, and obtained English assistance. Wellington drove the French from Spain, after many battles, nearly always fought with success. Napoleon was compelled to abdicate, and the Bourbon King again ruled in France.

3. Among the chief writers of the reign of Anne were Jonathan Swift who wrote strong political pamphlets, the *Battle of the Books*, *Gulliver's Travels*, and the *Tale of a Tub*. Pope, Addison, and Steele were famous essayists, Pope was also a poet, writing the *Rape of the Lock*, the translation of the *Iliad* and *Odyssey*, the *Dunciad*, the *Essay on Man* and *Essay on Criticism*. Dr. Sacheverell published political sermons and other pamphlets. Daniel Defoe wrote many political pamphlets.

4. In 1607 Virginia was colonised under a charter from James I. Massachusetts and New Hampshire were settled in by the Pilgrim Fathers in 1620—5. Several other states were acquired and colonised in the next 20 years, while in 1635 Jamaica was taken from the Dutch. Under the treaty of Breda we acquired New York and other states, the Virgin Isles, and Antigua, while Hudson's Bay Territory and British Columbia were settled under a charter of Charles II. Canada and the other provinces of British North America were finally acquired under the Treaty of Paris 1763, while the earlier founded states, now the United States, were lost during the War of Independence, ended by the Treaty of Verseilles 1783, which, however, gave us a number of the West India Islands. The Falkland Isles were ceded by Spain in 1771.

Sir Walter Raleigh, William Penn, Henry Hudson, and General Wolfe, are names associated with the settlement of America.

Australia was first colonised by Captain Philip in 1788, and the various divisions have been gradually made. In 1834 South Australia was established. In 1850 Victoria was created a separate colony, and in 1859 Queensland was severed from New South Wales. Western Australia will probably be made a self governing colony in 1890.

New Zealand was colonised in 1839., and the Fiji Islands became British Territory in 1874.

Captain Cook as discoverer, and Captain Philip as first settler, are names to be remembered in connection with Australia.

5. Arthur Wellesley, Duke of Wellington, was of Irish extraction. He was born in 1769, and died in 1852. He is spoken of as England's greatest general. He won his first victories in India at Assaye and Argaum, and afterwards bombarded Copenhagen with Gambier and Cathcart. His greatest successes were in connection with the war with France from 1803 to 1815. He drove the French out of Portugal at the battle of Vimiera, and won a great series of battles and sieges at Talavera, Busaco, Fuentes d'Onoro, Badajos, Ciudad Rodrigo, Salamanca, Vittoria, and the Pyrenees in Spain, and Toulouse in France, giving back Spain its own king, and compelling Napoleon to abdicate the throne of France. By the victories of Quatre Bras and Waterloo he completed the overthrow of Napoleon. Skilful as a general, he became afterwards an active politician. Was prime minister in 1828, and passed the repeal of the Test and Corporation Acts in that year, and Catholic Emancipation in 1829. He opposed Reform and resigned in 1830; but was one of the most trusted advisers of the Queen during the remainder of his life. He died in 1852, receiving a public funeral from the state, and was mourned by the whole of the people.

Teaching.

BOYS AND GIRLS.

(*Answer two questions only.*)

1. Write notes of a lesson on *one* of these subjects:—
   (*a*) Climate.
   (*b*) Reduction of money.
   (*c*) *For Infants.* Water and its uses.
   (*d*) A commercial port.

2. Describe the best system you know for teaching either (*a*) Numeration and notation *or* (*b*) Form and colour (*For Infants*).

3. Make four sums—two in direct and two in inverse proportion, and show how you would explain to a class the working of one of them.

4. What is meant by 'simultaneous' reading? How should it be conducted and what is the use of it?

(1) (*a*) *Climate.*

[To Stand. VI. Globe, map, blackboard, &c., needed.]

Introduce the lesson by rapid questioning about the different kinds of weather, and their knowledge of that experienced in other parts of the world. From this, in a few words, show the uses of the word *climate* to represent the various conditions. Give the derivation of the word, and show its applicability to that for which it is used. *Clima* (Lat.) to make to bend, or slope. Next proceed to show the various circumstances which produce or affect the climate of a country. These are rather numerous to treat fully. A general lesson would include them all, but subsequent lessons would be needed to develop the parts.

Circumstance affecting climate.

a. Nearness to the equator. The nearer the equator, the hotter; the further away, the colder. Why? Examples: India, Africa, Greenland, Siberia.

b. Elevation above the sea level. The higher we ascend, the colder it gets. Give reasons. Comparison of gradual elevation and gradual nearing the poles. Examples: The Alps and their productions. Quito. Some hills and valleys at home, if possible.

c. Proximity to the sea. Countries near the sea, warmer in winter and colder in summer than inland countries. State reasons fully. Examples: England, Russia.

d. Nature of prevailing winds. The direction in which winds usually blow has much to do with amount of heat and moisture of a country. Examples: Our own country, Ireland, Russia.

e. Character of the surrounding country. Whether hilly or flat, cultivated or uncultivated, marshy or dry. Examples: east and west of England, India, Siberia.

f. Indentations of coast and nature of currents. Examples: Gulf Stream and Polar current.

g. A combination of two or more of these causes. The above heads should be written on blackboard and should be committed to memory.

(2) To teach Numeration to young children use concrete examples. Make them familiar with units to ten. Then put ten marbles in a bag and call it one ten, letting the children fill the bags for themselves. Now put the bag with ten along with one, and afterwards more odd numbers up to two tens. Proceed this way with concrete examples up to 100. Practice this repeatedly till children are familiar with the tens. Repeat the numbers up to 100, letting a child put the tens bags out as they reach the 20, 30, &c. Put the numbers on the board to correspond. Do not attempt to teach higher numbers than 100 till children are perfectly familiar with those below. Next deal with abstract numbers apart from the bags. When children reach Standard I. the value of each figure to the left may be shown to be ten times the one to the same figure to the right.

The higher numbers in notation are much easier to teach if the value of those of three digits is thoroughly understood.

(3) *Direct.*—If six men earn £30, how much will 11 men earn in the same time?

If 9 horses can plough 14 acres a day, how many acres can 27 horses plough?

Indirect.—If I carry 10 tons 36 miles for £15, how far should I carry 24 tons for the same money?

What time ought 11 men to take to do a piece of work if 8 men do it in 6 days. I should (for the first sum) ask what was required. [Ans. To know how much money 11 would earn.] Then what the sum told us. [Ans. 6 men earn £30.]

Put that statement on the board in this form:

Money earned by 6 men = £30.

From the mental arithmetic questions previously given, every one would be able to tell how much one would earn, and how to obtain it [by dividing £30 by 6]. Write this under the other, thus:

Money earned by 1 man = £30 ÷ 6 = £5.

Now ask for the earnings of 11 men. [Ans. £55.] How obtained? [Eleven times as much as one.] Write this under the other, thus:

Money earned by 11 men = £5 × 11 = £55.

In inverse proportion the second item would be a little more difficult, but would be got over by questioning before attempting to write anything down.

(4) By 'simultaneous reading,' we mean the reading of the same piece by a whole class at the same time, each word being repeated by the class at the same moment.

It should not be attempted by young children till the words forming the lesson have been made familiar either by individual practice or by a pattern given by the teacher.

'Simultaneous reading' is then useful, for it supplies continuous reading to a whole class at once, aiding in giving command of the organs of the voice, without which reading cannot be fluent. It corrects haste in some and slowness in others, since each has to make an effort to keep up with his fellows. It improves the style and tone; and after a proper pattern gives intelligence and expression to the reading. Too much is harmful as tending to make the reading somewhat artificial, and correctness is sacrificed to uniformity of speed and tone. Combined with a proper amount of individual reading it is helpful as indicated.

END OF FOURTH YEAR.

FIRST PAPER.

(Three hours and a half allowed.)

Euclid.

BOYS ONLY.

[All generally understood abbreviations and symbols for words may be used, but not symbols of operation, such as −, +, ×.]

(Answer two questions, including Question 3, if you can do so.)

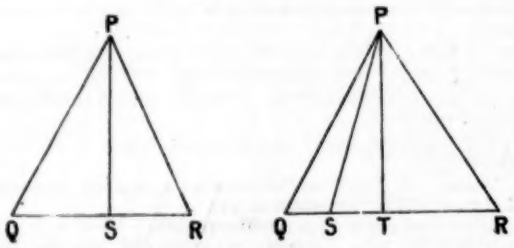
1. The complements of the parallelograms which are about the diameter of any parallelogram are equal to one another.

Euclid: Book I., Prop. 42.

2. In obtuse-angled triangles, if a perpendicular be drawn from either of the acute angles to the opposite side produced, the square on the side subtending the obtuse angle is greater than the squares on the sides containing the obtuse angle by twice the rectangle contained by the side on which, when produced, the perpendicular falls, and the straight line intercepted without the triangle between the perpendicular and the obtuse angle.

Euclid: Book II., Prop. 12.

3. In the isosceles triangle PQR, PS is drawn from the vertex to meet the base in S. Prove that the difference between the squares on PQ (one of the equal sides), and on PS, is equal to the rectangle contained by QS, SR.



In the isosceles △ PQR, if PS be drawn perpendicular to QR, then (I. 26) QS = QR, and the rectangle QS, SR = the sq. on QS.

And (I. 47) sq. on PQ = sqs. on QS, SP, that is the sq. on PQ is ∠ sq. on PS by the sq. on QS, *i.e.*, by the rect. QS, SR.

But if PS be not perpendicular, then draw PT perpendicular to QR.

Then (II., 5) sq. on QT = rect. QS, SR together with the sq. on ST.

To each add the sq. on TP.

Then sqs. on QT, TP = sqs. on ST, TP together with rect. QS, SR.

But sq. on QP = sqs. on QT, TP (I. 47), and sq. on SP = sqs. on ST, TP (I. 47).

∴ sq. on QP = sq. on SP together with rect. QS, SR.

i.e. sq. on QP is ∠ sq. on SP by the rect. QS, SR.

Q.E.D.

Algebra.

BOYS ONLY.

(Answer three questions, including Questions 1 and 4, if you can do so.)

1. Prove that the least common multiple of two algebraical expressions is their product divided by their greatest common measure.

Find the G.C.M. of $4a^4 - 2a^3 + 3a - 9$ and $2a^4 - 2a^3 + a^2 + 3a - 6$.

2. Simplify—

(1) $\frac{2a}{(3x-2a)^2} + \frac{2}{3(x-a)} - \frac{3x-a}{9x^2-15ax+6a^2}$.

(2) $\left(\frac{1}{a+b} + \frac{1}{a-b} - \frac{4a}{a^2-b^2} - \frac{2a}{a^2+b^2}\right) \div \frac{a}{a+b}$.

3. The sum and the difference of a number of two digits and of the number formed by reversing the digits are 176 and 18 respectively: find the numbers.

4. Solve the equations—

(1) $\begin{cases} \frac{3x-y}{5} - \frac{3y-x}{3} = 22 \\ 5x - 3y = 135. \end{cases}$

(2) $6x^2 - 43x = -77$.

1. Let x and y be the two expressions and z their common measure.

If $x = az$ and $y = bz$, then from the nature of the greatest common measure, a and b are prime to each other, and their least common multiple is ab.

But the least common multiple of x and y must contain the common factor z and the factors prime to each other a and b.

Therefore the least common multiple of x and y must contain the factors a, b, and z, and $abz = \frac{x \times y}{z}$, that is the L.C.M. of two algebraical expressions equals their product ÷ their G.C.M.

$2a^4 - 2a^3 + a^2 + 3a - 6)4a^4 - 2a^3 + 3a - 9(2$
$\quad 4a^4 - 4a^3 + 2a^2 + 6a - 12$
$\quad 2a^3 - 2a^2 - 3a + 3$

$2a^3 - 2a^2 - 3a + 3)2a^4 - 2a^3 + a^2 + 3a - 6(a$
$\quad 2a^4 - 2a^3 - 3a^2 + 3a$
$\quad 2)4a^2 - 6$
$\quad 2a^2 - 3)$

$2a^2 - 3)2a^3 - 2a^2 - 3a + 3(a - 1$
$\quad 2a^3 - 3a$
$\quad - 2a^2 + 3$
$\quad - 2a^2 + 3$

G.C.M. = $\underline{2a^2 - 3}$. Ans.

2.

(1) $\frac{2a}{(3x-2a)^2} + \frac{2}{3(x-a)} - \frac{3x-a}{9x^2-15ax+6a^2}$

$= \frac{2a(3x-3a) + 2(3x-2a)^2 - (3x-a)(3x-2a)}{(3x-2a)^2(3x-3a)}$

$= \frac{6ax - 6a^2 + 18x^2 - 24ax + 8a^2 - 9x^2 + 9ax - 2a^2}{(3x-2a)^2(3x-3a)}$

$= \frac{9x^2 - 9ax}{(3x-2a)^2(3x-3a)}$

$= \frac{3x}{(3x-2a)^2}$

(2) $\left(\frac{1}{a+b} + \frac{1}{a-b} - \frac{4a}{a^2-b^2} - \frac{2a}{a^2+b^2}\right) \div \frac{a}{a+b}$

$= \left(\frac{a-b+a+b}{a^2-b^2} - \frac{2a}{a^2+b^2} - \frac{4a}{a^2-b^2}\right) \div \frac{a}{a+b}$

$= \left(\frac{2a}{a^2-b^2} - \frac{2a}{a^2+b^2} - \frac{4a}{a^2-b^2}\right) \div \frac{a+b}{a}$

$= \frac{2a(a^2+b^2) - 2a(a^2-b^2) - 4a(a^2+b^2)}{(a^2-b^2)(a^2+b^2)} \div \frac{a}{a+b}$

$= \frac{-4a^3}{(a^2-b^2)(a^2+b^2)} \times \frac{a+b}{a}$

$= \frac{-4a^2}{(a-b)(a^2+b^2)}$

$= \underline{\frac{-4a^2}{a^3 - a^2b + ab^2a - b^3}}$ Ans.

3. Let x = the tens figure.
y = the units figure.
$\therefore 10x + y$ = the number,
and $10y + x$ = the number with digits reversed.

$(10x + y) + (10y + x) = 176$
$(10x + y) - (10y + x) = 18$
$11x + 11y = 176$
$9x - 9y = 18$
$x + y = 16$
$x - y = 2$
$2x = 18$
$x = 9$
$y = 16 - 9 = 7.$
Numbers = 97 and 79. Ans.

4.
$$\begin{cases} \frac{3x - y}{5} - \frac{3y - x}{3} = 22 \\ 5x - 3y = 135 \end{cases}$$
$$\begin{cases} 9x - 3y - 15y + 5x = 330 \\ 5x - 3y = 135 \end{cases}$$
(I) $14x - 18y = 330$
(II) $5x - 3y = 135$
Mult. II. by 6.
$14x - 18y = 330$
$30x - 18y = 810$
$-16x = -480$
$x = 30$
$5x - 3y = 135$
$150 - 3y = 135$
$y = 5.$

(5) $6x^2 - 43x = -77$
$x^2 - \frac{43}{6}x + (\frac{43}{12})^2 = -\frac{77}{6} + \frac{1849}{144} = \frac{121}{144}$
$x - \frac{43}{12} = \pm \frac{11}{12}$
$x = \pm \frac{11}{12} + \frac{43}{12}$
$= \frac{54}{12}, \frac{32}{12}$
$= 3\frac{1}{2}, 3\frac{1}{3}$. Ans.

English Grammar and Composition.

BOYS AND GIRLS.

(*Answer Questions* 1 *and* 2, *and one other only.*)

1. Paraphrase this passage :—

Her court was pure ; her life serene ;
God gave her peace; her land reposed ;
A thousand claims to reverence closed
In her as mother, wife and queen :
And statesmen at her council met
Who knew the seasons, when to take
Occasion by the hand, and make
The bounds of freedom wider yet
By shaping some august decree,
Which kept her throne unshaken still
Broad based upon her people's will
And compassed by the inviolate sea.

2. Analyse the last eight lines.

3. Take each of the following words, tell its precise meaning and its origin, and place it in an appropriate sentence :—

Illimitable.	Retrograde.	Transportation
Continent.	Uncouth.	Witangemote.
Amity.	Auriferous.	Correlative.

4. What is meant in grammar by the words *Elliptical*, *Demonstrative*, *Superlative*, *Subjunctive*, and *Nominative Absolute*? Give examples.

Parse the sentence—

'What in me is dark,
Illumine.'

6. Who were the principal English poets of the 17th century, and what were their principal works?

(1) Vice found no place at her court : her life passed calmly and peacefully, through the blessing of God, and her country enjoyed the repose which follows absence of war and strife. In the capacity of mother, wife and queen, she acted so as to earn a thousand claims to respect and love. Her ministers wise and prudent, knew well the signs of the times, and at the right moment passed such just laws as gave greater liberty to the people, thus increasing their loyalty to the throne, making the throne more stable, its foundations being based upon the people's wishes, and her kingdom being surrounded by the sea.

(2) (*a*) And statesmen met at her council.
(Prin. sent.)
Connec. : And.
Subj. : statesmen.
Pred. : met.
Ext. of Pred. : at her council.

(*b*) Who knew the seasons when to take occasion by the hand and make the bounds of freedom wider yet by shaping some august decree. (Adj. sent. to *a*.)
Subj. : who.
Pred. : knew.
Obj. : the seasons, when to take . . . decree.

(*c*) Which kept her throne unshaken still broad based upon her people's will and compassed by the inviolate sea.
(Adj. sent. to *b*.)
Subj. : which.
Pred. : kept.
Obj. : her throne, broad based . . . . . sea, unshaken still.

(3) *Illimitable*, that cannot be bounded ; infinite. Lat. *il*, *in*, not, and *limes*, *limitis*, transverse, and *able*, adj. termination, may be. The world was cast into illimitable space.

Continent, containing many countries, from Lat. *con*, together, and *teneo*, I hold, *ent*, suffix. Africa is known as the 'dark continent.'

Amity, friendship, goodwill, from Lat. *amicus*, a friend. No signs of amity appeared during their interview with each other.

Retrograde, going backwards, from Lat. *retro*, backward, and *gradus*, a step; *gradior*, to go. His conduct has been retrograde for a long time.

Uncouth, unknown, unfamiliar, odd, awkward ; from A.-S. *un*, not, and *cudh*, known. His manners were most uncouth.

Auriferous, gold-bearing, from Lat. *aurum*, gold, and *fero*, I bear ; *ous*, affix. They discovered an auriferous reef in the hill.

Transportation, the act of removing ; banishment, from Lat. *trans*, across, and *porto*, I carry ; and affix. He was sentenced to five years' transportation.

Witangemote, the assembly of wise men ; from A.-S. *witan*, wise, *gemote*, an assembly. The Saxon parliament was called the Witangemote.

Correlative, mutually related, from Lat. *cor*, together, *re*, back, and *latum*, carried. Either and or are correlative conjunctions.

(4) *Elliptical*, having a word or words omitted, as, The sun rose and cast its golden beams across the sea. In this sentence the words *the sun* should be repeated before cast.

Demonstrative, pointing out, as, *This* box is very heavy, where this is a demonstrative or distinguishing adjective.

Superlative, having the quality in its highest or lowest degree, as The *best* fruit is obtained from the south.

Subjunctive, containing a condition, as, If I be here, I shall do as you wish.

Nominative absolute, the nominative used.

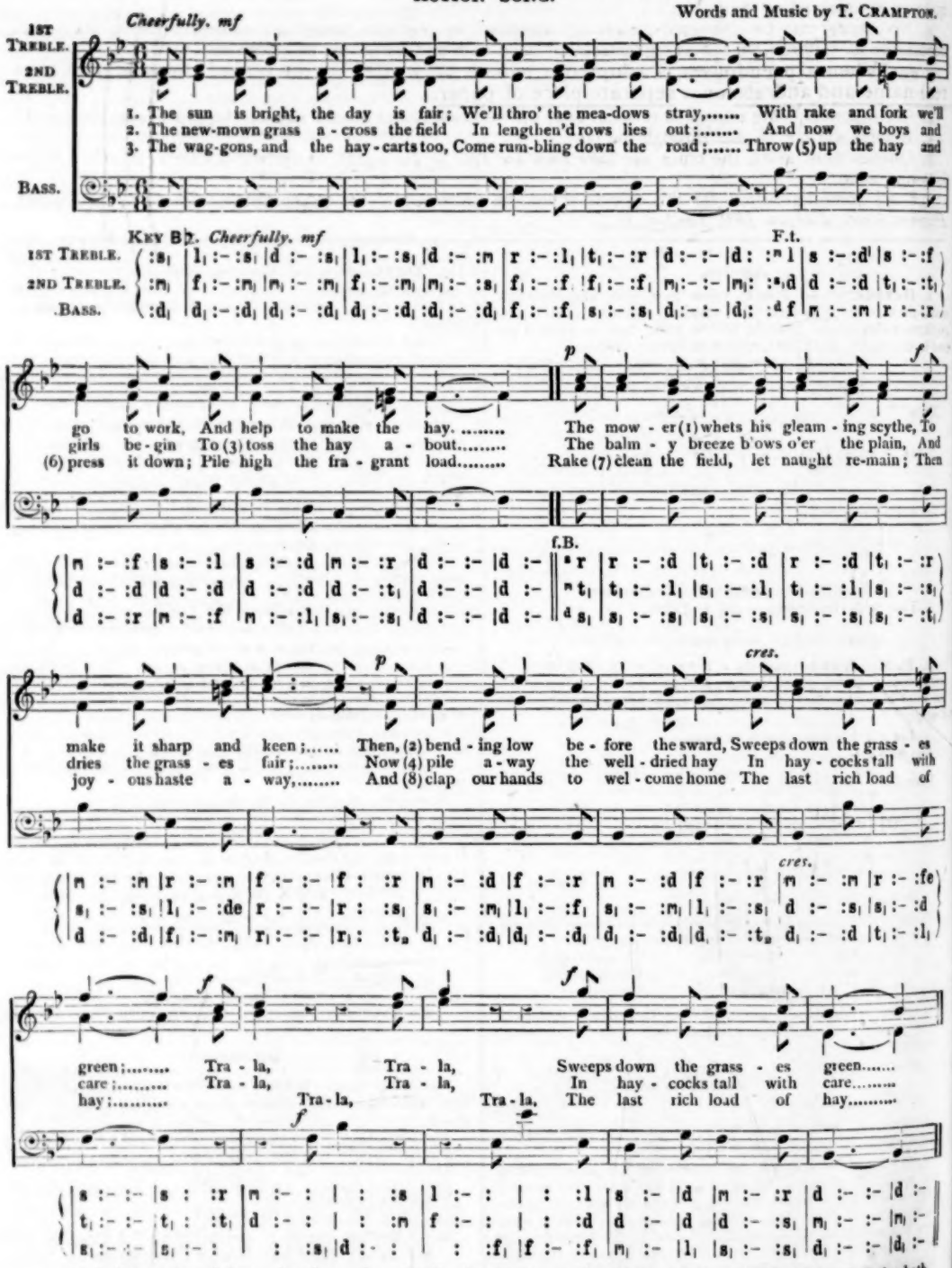
(5)
What—a compound relative pronoun, including antecedent and relative, equivalent to *that which* or the *thing which*—*that*, objective case, gov. by the trans. verb *illumine*; *which*, rel. pro., neut., sing. 3rd, nom. case to *is*.
in—prep., showing relation between *me* and *is*.
me—pers. pro., masc., sing., 1st pers., obj., gov. by *in*.
is—irreg. intrans. verb, act., ind., pres., 3rd sing., agreeing with its nom. *which*, included in *what*.
dark—adj. of quality, qualifying *which*.
illumine verb, reg. trans., act., imp., 2nd sing., agreeing with its nom. *thou*.

(6)
William Shakespeare (1616) ; thirty-seven plays—Tragedies : Hamlet, Lear, Othello ; Comedies : Merchant of Venice, Midsummer Night's Dream, and As you Like it ; Historical Plays : Julius Cæsar, Richard III.
Ben Jonson (1637) ; Tragedies and Comedies : Every Man in his Humour ; Volpone, or the Fox.
Thomas Hobbes (1649) : Sonnets and Poems.
John Milton (1674) : Paradise Lost and Regained ; Samson Agonistes ; Comus.
Samuel Butler (1680) : Hudibras.
John Dryden (1700) : Annus Mirabilis ; Absalom and Achitophel ; Hind and Panther ; Translation of Virgil's Æneid.

(To be continued.)

THE YOUNG HAYMAKERS.

ACTION SONG.

Words and Music by T. CRAMPTON.

1ST TREBLE.
2ND TREBLE.
BASS.
Cheerfully. mf
1. The sun is bright, the day is fair; We'll thro' the mea-dows stray,..... With rake and fork we'll
2. The new-mown grass a - cross the field In lengthen'd rows lies out;..... And now we boys and
3. The wag-gons, and the hay - carts too, Come rum-bling down the road;..... Throw (5) up the hay and
KEY B♭. Cheerfully. mf
F.t.
p
f
go to work, And help to make the hay. .....
girls be - gin To (3) toss the hay a - bout.....
(6) press it down; Pile high the fra - grant load.....
The mow - er (1) whets his gleam - ing scythe, To
The balm - y breeze blows o'er the plain, And
Rake (7) clean the field, let naught re-main; Then
f.B.
p
cres.
make it sharp and keen;..... Then, (2) bend - ing low be - fore the sward, Sweeps down the grass - es
dries the grass - es fair;..... Now (4) pile a - way the well - dried hay In hay - cocks tall with
joy - ous haste a - way,..... And (8) clap our hands to wel - come home The last rich load of
cres.
f
green;..... Tra - la, Tra - la, Sweeps down the grass - es green.....
care;..... Tra - la, Tra - la, In hay - cocks tall with care.....
hay;..... Tra - la, Tra - la, The last rich load of hay.....

(1) Imitate action of sharpening the scythe. (2) Bend as in the act of mowing. (3) Toss both hands. (4) Raise both hands as in piling hay. (5) Toss up hands as with a hay-fork. (6) Press down with the feet. (7) Imitate act of raking up the hay. (8) Clap hands vigorously.

Query Column.

RULES.

1. **Each correspondent is restricted to *one question*.** We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Algebra.

1. HERBERTUS.—I row 15 miles on a river and back the same distance in $7\frac{1}{2}$ hours. If a unifosm current causes me to go three miles in one direction in the same time in which I go two in the other, find how long I take in each direction.

(*Naval Cadets' Exam. Paper, Nov.* 1889.)

Let x = rate per hour in miles with the stream,

Then $\frac{2x}{3}$ = " " against "

$$\therefore (15 \div x) + \left(15 \div \frac{2x}{3}\right) = 7\tfrac{1}{2}$$

$$\frac{15}{x} + \frac{45}{2x} = 7\tfrac{1}{2}$$

$$\frac{1}{x} + \frac{3}{2x} = \tfrac{1}{2}$$

$$2 + 3 = x$$

$$\therefore x = 5.$$

$\therefore$ Time with the stream $= (15 \div 5)$ hrs.
$= 3$ hrs.
" against " $= 4\frac{1}{2}$ hrs.

2. H. M.—A and B can do a piece of work in m days; A works n days alone, when B joins him and both together finish the work in p days more; how long would either require to do it singly?

Let x = time it takes A in days,
And let y = " " B " ;

Then (1) $\frac{1}{x} + \frac{1}{y} = \frac{1}{m}$

(2) $\left(1 - \frac{n}{x}\right) \div \left(\frac{1}{x} + \frac{1}{y}\right) = p$

$$\left(1 - \frac{n}{x}\right) \div \frac{1}{m} = p$$

$$1 - \frac{n}{x} = \frac{p}{m}$$

$$\frac{n}{x} = 1 - \frac{p}{m}$$

$$= \frac{m - p}{m}$$

$$\therefore x = \frac{mn}{m - p}.$$

(1) $\frac{1}{x} + \frac{1}{y} = \frac{1}{m}$

$$\frac{m - p}{mn} + \frac{1}{y} = \frac{1}{m}$$

$$\frac{1}{y} = \frac{1}{m} - \frac{m - p}{mn}$$

$$= \frac{n - m + p}{mn}$$

$$\therefore y = \frac{mn}{n + p - m}.$$

A can do the work in $\frac{mn}{m - p}$ days,

B " " $\frac{mn}{n + p - m}$ days.

3. ELEVE.—If $a + b + c = 0$, show that $a^4 + b^4 + c^4 = 2(ab + bc + ca)^2$.

(*Scholarship, 1880.*)

$$a + b + c = 0$$

$$(a + b + c)^2 = 0$$

$$a^2 + b^2 + c^2 + 2(ab + bc + ca) = 0$$

$$a^2 + b^2 + c^2 = -2(ab + bc + ca)$$

$$(a^2 + b^2 + c^2)^2 = 4(ab + bc + ca)^2$$

$$a^4 + b^4 + c^4 + 2(a^2b^2 + b^2c^2 + c^2a^2) = 4(ab + bc + ca)^2$$

$$a^4 + b^4 + c^4 = 4[a^2b^2 + b^2c^2 + c^2a^2 + 2(a^2bc + ab^2c + abc^2)]$$

$$- 2(a^2b^2 + b^2c^2 + c^2a^2) = 2(a^2b^2 + b^2c^2 + c^2a^2) + 8(a^2bc + ab^2c + abc^2)$$

$$= 2[a^2b^2 + b^2c^2 + c^2a^2 + 2(a^2bc + ab^2c + abc^2)] + 4(a^2bc + ab^2c + abc^2)$$

$$= 2(ab + bc + ca)^2 + 4abc(a + b + c)$$

But $a + b + c = 0$,

$$\therefore 4abc(a + b + c) = 0;$$

$$\therefore a^4 + b^4 + c^4 = 2(ab + bc + ac)^2.$$

4. P. T.—Simplify :—

$$\frac{1}{2x + 2} - \frac{4}{x + 2} + \frac{9}{2(x + 3)} - \frac{x - 1}{(x + 2)(x + 3)}.$$

(*Evans's* 'Test Cards.')

$$\frac{1}{2x + 2} - \frac{4}{x + 2} + \frac{9}{2(x + 3)} - \frac{x - 1}{(x + 2)(x + 3)}$$

$$= \frac{1}{2(x + 1)} - \frac{4}{x + 2} + \frac{9}{2(x + 3)} - \frac{x - 1}{(x + 2)(x + 3)}$$

$$= \frac{(x + 2)(x + 3) - 8(x + 1)(x + 3) + 9(x + 1)(x + 2) - 2(x + 1)(x - 1)}{2(x + 1)(x + 2)(x + 3)}$$

$$= \frac{x^2 + 5x + 6 - 8x^2 - 32x - 24 + 9x^2 + 27x + 18 - 2x^2 + 2}{2(x + 1)(x + 2)(x + 3)}$$

$$= \frac{2}{2(x + 1)(x + 2)(x + 3)}$$

$$= \frac{1}{(x + 1)(x + 2)(x + 3)}.$$ Ans.

Arithmetic.

1. O. X.—A and B have 14s. 6d. between them, A and C have 11s 6d., and B and C have 13s. 4d.; how much has each? (*Ledsham.*)

Twice the shares of A, B, and C
= 14s. 6d. + 11s. 6d. + 13s. 4d.
= 39s. 4d.,

Shares of A, B, and C = 39s. 4d. ÷ 2
= 19s. 8d.,

$\therefore$ A's share = 19s. 8d. — 13s. 4d. = 6s. 4d.
B's " = 19s. 8d. — 11s. 6d. = 8s. 2d.
C's " = 19s. 8d. — 14s. 6d. = 5s. 2d.

Note.—In the answer the shares of A and B = 14s. 6d., and therefore this amount cannot equal the shares of A, B, and C. The question as given is therefore incorrect.

2. PRO BONO PUBLICO.—I invest my capital in the following shares:—50 Insurance (£2 paid up) at 70s., yielding 15 per cent. dividend; 50 Bank shares (£1 paid up) at 45s., returning 20 per cent. dividend; 5,000 Fire Insurance shares (par value 2s.) at 1s. 10d., on which I receive 8 per cent. dividend; 10 Steam shares (fully paid up to £20) at £21, with a dividend of 10 per cent.; and £265 Gold shares (£1 paid up) at 3s. 4d. yielding no dividend. What rate of interest do I get on each investment, and what average rate per cent. on the whole of my capital?

(1) Amount paid for Insurance shares = 70s. × 50
= £175;
Dividend = 15 % on (£2 × 50)
= £15;
Rate of Interest = 15 % × $\frac{40}{175}$
= $8\frac{4}{7}$ %.

(2) Amount paid for Bank shares = 45s. × 50
= £112 10s.;
Dividend = 20 % on (£1 × 50)
= £10;
Rate of interest = 20 % × $\frac{20}{225}$
= $8\frac{8}{9}$ %.

(3) Amount paid for Fire Insurance shares = 1s. 10d. × 5,000
= £458 6s. 8d.;
Dividend = 8 % on (2s. × 5,000)
= 8 % on £500
= £40;
Rate of interest = 8 % × $\frac{24}{55}$
= $8\frac{8}{11}$ %.

(4) Amount paid for Steam shares = £21 × 10
= £210;
Dividend = 10 % on (£20 × 10)
= £20;
Rate of Interest = 10 % × $\frac{20}{210}$
= $9\frac{1}{21}$ %.

(5) Amount paid for Gold shares = 3s. 4d. × 265
= £44 3s. 4d.;
Dividend = Nothing;
Rate of interest = Nothing.

(6) Capital = £175 + £112 10s.
+ £458 6s. 8d. + £210 + £44 3s. 4d.
= £1,000;
Total dividend = £15 + £10 + £40 + £20
= £85;
∴ Average rate of interest = £85 × $\frac{1000}{1000}$
= $8\frac{1}{2}$ %.

3. M. H.—A woman sold $7\frac{1}{2}$ dozen eggs for 6s. 2d., some at the rate of 3 for $2\frac{1}{2}$d., and the rest at 8 for $6\frac{1}{2}$d. How many were sold at each rate?

(*Colense.*)

Average selling price = $\frac{6\text{s. }2\text{d}}{90}$ = $\frac{37}{45}$d.;

Selling price of each in 1st lot = $\frac{2\frac{1}{2}\text{d.}}{3}$ = $\frac{5}{6}$d.,

" " 2nd " = $\frac{6\frac{1}{2}\text{d.}}{8}$ = $\frac{13}{16}$d.;

Difference between average price and price of those in 1st lot
= $\frac{5}{6}$d. − $\frac{37}{45}$d.
= $\frac{75 - 74}{90}$ d.
= $\frac{1}{90}$d.;

Difference between average price and price of those in 2nd lot
= $\frac{13}{16}$d. − $\frac{37}{45}$d.
= $\frac{592 - 585}{720}$ d.
= $\frac{7}{720}$d.;

∴ No. in 1st lot : No. in 2nd lot :: $\frac{7}{720}$d. : $\frac{1}{90}$d. :: 7 : 8;
7 + 8 = 15; $7\frac{1}{2}$ dozen ÷ 15 = 6;
∴ No. in 1st lot = 6 × 7 = 42
" 2nd " = 6 × 8 = 48 } Ans.

Note.—Edge of square = $\sqrt{\frac{1}{2}\text{ diagonal}^2}$;
" cube = $\sqrt{\frac{1}{3}\text{ diagonal}^2}$.

4. F. S.—If L be the least common multiple of A and B show that $\frac{L}{A}$, $\frac{L}{B}$ have no factor in common, and that they are in the proportion of B : A. Is a similar proposition true of three quantities, A, B, C, and their least common multiple M?

(*India Forest Exam., June*, 1881.)

(*a*) Let A be contained in L *m* times, and let B be contained in L *n* times.

Then L = *m* A, and L = *n* B
∴ $\frac{L}{A} = m$, and $\frac{L}{B} = n$.

Since L is the least common multiple of A and B, *m* and *n* have no common factor.

∴ $\frac{L}{A}$ and $\frac{L}{B}$ have no common factor.

$\frac{L}{A} : \frac{L}{B} = \frac{1}{A} : \frac{1}{B}$
= B : A.

(*b*) It can be proved similarly that $\frac{M}{A}$, $\frac{M}{B}$, $\frac{M}{C}$ have no common factor.

$\frac{M}{A} : \frac{M}{B} : \frac{M}{C} = \frac{1}{A} : \frac{1}{B} : \frac{1}{C}$
= BC : AC : AB.

∴ Similar ratio is not true of three quantities.

$\frac{M}{A} : \frac{M}{B}$ = B : A,

$\frac{M}{B} : \frac{M}{C}$ = C : B,

and $\frac{M}{A} : \frac{M}{C}$ = C : A.

$\frac{M}{A}$ and $\frac{M}{B}$ may have a common factor,

$\frac{M}{B}$ and $\frac{M}{C}$ " " "

$\frac{M}{A}$ and $\frac{M}{C}$ " " .

General.

1. F. SMITH.—Your query resolves into a bi-quadratic equation. Putting BD = *x* and BE = *y*, we have

$\frac{BD}{BC} = \frac{BE}{BA}$

$\frac{x}{x + 20} = \frac{y}{50}$

$\therefore y = \frac{50x}{x + 20}$.

And $y^2 = x^2 + 10^2$

$\therefore \left(\frac{50x}{x + 20}\right)^2 = x^2 + 100$

$2{,}500x^2 = (x^2 + 100)(x^2 + 40x + 400)$
$= x^4 + 40x^3 + 500x^2 + 4{,}000x + 40{,}000$

$x^4 + 40x^3 - 2{,}000x^2 + 4{,}000x + 40{,}000 = 0$.

Now this bi-quadratic equation has no integral or rational solution, and therefore the dimensions given must be incorrect.

2. A CONSTANT READER.—A thin rod of uniform density and weight w_1, whose specific gravity is *s*, has a weight *w*, which is to be treated as a *particle*, fastened to one end. Show that *w* must be less than $w_1\left(\frac{1}{s} - 1\right)$ or the rod would not float, and greater than $w_1\left(\frac{1}{\sqrt{s}} - 1\right)$ or the rod would not float vertically. (*Twisden's* 'Theoretical Mechanics,' p. 212.)

For the rod just to float the weight of the displaced water must be equal to the weight of the body immersed + the weight of the particle.

$\therefore w + w_1 = \frac{w_1}{s}$

$\therefore w = w_1\left(\frac{1}{s} - 1\right)$.

For the rod just to float vertically the centre of gravity of the displaced water must coincide with the combined centre of gravity of the rod and the particle, and the combined weight of particle and rod must be equal to that of the displaced water.

Suppose A B the rod, C its middle point, D the position to which the water comes when it is floating vertically.

Let $BA = l$. $BD = x$.

From first condition we get

$$w_1 \frac{l}{2} = (w + w_1) \frac{x}{2}. \quad (1)$$

From the second condition we get

$$w + w_1 = \frac{w_1}{s} \cdot \frac{x}{l}. \quad (2)$$

Dividing (1) by (2) we get

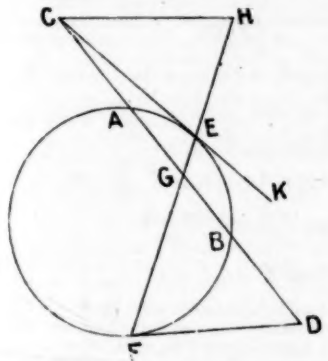
$$\frac{w_1}{w + w_1} = \frac{w + w_1}{w_1} s$$

$$\therefore w_1^2 = (w + w_1)^2 s$$

$$w = w_1 \left(\frac{1}{\sqrt{s}} - 1\right).$$

3. CYCLOPS.—A chord AB of a circle is produced both ways to C and D, so that AC = BD, and from C and D tangents are drawn to the circle on opposite sides of CD. Show that the line joining the points of contact bisects the chord.

(*Wilson's Geometry.*)



Let AB be the given chord, and let AB be produced to C and D, making AC = BD. From C and D draw the tangents CE and FD to the circle AEBF. Join EF. Then EF meets AB in G. It is required to prove that AG = BG.

Draw CH parallel to DF, cutting FE in H.

∵ CE touches the circle and CB cuts it,

∴ CE^2 = CA CB.

Also ∵ DF touches circle, and DA cuts it,

∴ DF^2 = DB DA;

and since DB = AC

∴ AD = BC and DB DA = CA CB

∴ DF^2 = CE^2 and DF = CE.

Since CE and DF touch the circle ABF, and the line FE is drawn from the point of contact,

∴ angle DFG and angle KEC = angle in segment EAF, and angle HEC = angle KEG,

∴ angle HEC = angle DFC.

But CH is parallel to DF, and HF meets them;

∴ angle CHE = angle DFG = angle CEH,

∴ CH = CE

∵ in the triangles CHG and DGF the angle CHG = angle DFG and angle HGC = angle DGF, and side CH = side DF,

∴ CG = GD,

and CA = DB,

∴ AG = BG.

4. C. N. W.—Yes, no doubt; but you will not find the sort of books you want with keys. For Geometry you can use Wilson's book. For Geometrical Cones, Besant's or Richardson's. For Euclid, as far as Book VI., you would find Mackay's book excellent.

5. ROSEBUD.—The new Code has not yet come into operation. There may be a few corrections and changes. For the future the Scholarship Examination will be of much greater importance. It will be necessary for all pupil teachers to pass it. Why not take the present one, July, 1890?

6. DEVA.—Large hand too upright. Some of the curves are ragged. This arises from the way the pen is held. All the letters lack elegance. 60 per cent. The small hand is better. The capitals are weak, the letter W especially. Use better materials and study evenness and smoothness. 65 per. cent.

7. MATRIC.—Always give the correct reference. You said Livy, Bk. I., 36, 9. No such passage as you quote is in chapter 36. Refer for yourself. The passage runs literally thus:—Spectavere, they watched; furcis sustinentibus, props supporting; spectacula, the seats; duodenos pedes, twelve feet each; alta ab terra, high from the ground.

8. CHELTONIAN.—We shall always be glad to answer your questions. We do not know of any pupil teacher's examination such as you name. But to make sure you could write to the Hospital, Chelsea, S.W.

Trigonometry.

1. HIGHLANDER.—In any triangle prove the formula

$$\tan \frac{A}{2} = \pm \sqrt{\left\{\frac{(s-b)(s-c)}{s(s-a)}\right\}},$$

and show from it that if $a = 5$, $b = 3$, $c = 4$, then A will be a right angle. Can you give any explanation of the double sign?

(*College of Preceptors*, July, 1886.)

$$\text{Cos A} = \frac{b^2 + c^2 - a^2}{2bc}$$

$$1 - \cos A = 1 - \frac{b^2 + c^2 - a^2}{2bc}$$

$$= \frac{a^2 - (b-c)^2}{2bc},$$

$$\therefore \text{Sin}^2 \frac{A}{2} = \frac{(a + b - c)(a + c - b)}{4bc}.$$

Let $2s = a + b + c$, so that s is half the sum of the sides of the triangle; then

$$a + b - c = a + b + c - 2c = 2(s - c),$$
$$a + c - b = a + b + c - 2b = 2(s - b).$$

$$\text{Sin}^2 \frac{A}{2} = \frac{(s-b)(s-c)}{bc},$$

$$\therefore \text{Sin} \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}.$$

$$1 + \cos A = 1 + \frac{b^2 + c^2 - a^2}{2bc}$$

$$= \frac{(b+c)^2 - a^2}{2bc},$$

$$\text{Cos}^2 \frac{A}{2} = \frac{(a + b + c)(b + c - a)}{4bc}$$

$$= \frac{s(s-a)}{bc}$$

$$\therefore \text{Cos} \frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}},$$

From the values of $\sin \frac{A}{2}$ and $\cos \frac{A}{2}$ we deduce

$$\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}.$$

There are two values of a square root, but the positive sign must be given, because in the value

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc},$$

the angle A is acute, and therefore $\tan \frac{A}{2}$ is positive.

If $a = 5$, $b = 3$, $c = 4$,

then $\sqrt{\frac{(s-b)(s-c)}{s(s-a)}} = \sqrt{\frac{3 \times 2}{6 \times 1}} = 1.$

$$\therefore \tan \frac{A}{2} = 1,$$

$$\frac{A}{2} = 45°,$$

$$\therefore A = \text{a right angle.}$$

2. A STUDENT.—If regular polygons of n and $2n$ sides have the same perimeter, prove that the radius of the circle circumscribed about the first is a third proportional to the radii of the circles inscribed in and circumscribed about the second polygon.

From any point within a regular polygon of n sides let fall a perpendicular upon each of the sides; show that the sum of these perpendiculars is equal to the radius of the inscribed circle of a regular polygon of the same number of sides as the original polygon, but having a perimeter n times as large.

(*Science and Art, Stage IV.*)

(*a*) Let r = radius of inscribed circle of second polygon,
and R^1 and R = radii of circumscribed circles of first and second polygons,
also let $2a$ = side of first polygon,

Then a = ,, second polygon;

$$\therefore r = \frac{a}{2\tan\frac{\pi}{2n}},$$

$$R = \frac{a}{2\sin\frac{\pi}{2n}},$$

$$R^1 = \frac{2a}{2\sin\frac{\pi}{n}} = \frac{a}{\sin\frac{\pi}{n}},$$

Third proportional to r and R

$$= \left(\frac{a}{2\sin\frac{\pi}{2n}}\right)^2 \div \frac{a}{2\tan\frac{\pi}{2n}}$$

$$= \frac{a}{2\sin^2\frac{\pi}{2n} \div \tan\frac{\pi}{2n}}$$

$$= \frac{a}{2\sin^2\frac{\pi}{2n} \times \frac{\cos\frac{\pi}{2n}}{\sin\frac{\pi}{2n}}}$$

$$= \frac{a}{2\sin\frac{\pi}{2n}\cos\frac{\pi}{2n}}$$

$$= \frac{a}{\sin\frac{\pi}{n}}$$

$$= R^1.$$

(*b*) Let side of polygon = $2a$.

The polygon can be divided into n triangles by lines drawn to the angular points from any point within it.

Area of each triangle = $\frac{1}{2}$ side × perpendicular
= a × perpendicular,
$\therefore$ Area of polygon = a × sum of perpendiculars;
But area of polygon = $na^2 \cot\frac{\pi}{n}$,

$\therefore$ Sum of perpendiculars = $na\cot\frac{\pi}{n}$.

The radius of a circle inscribed in a regular polygon of n sides whose sides are each $2na = na\cot\frac{\pi}{n}$.

$\therefore$ Sum of perpendiculars = radius of inscribed circle of a regular polygon of n sides, but having a perimetsr n times as great as the first polygon.

Science.

1. W. G.—A beam of fir, supported at each end, is inclined at an angle of 60° to the horizon, and is loaded at the centre of its length with a weight of 1 ton. The length of the beam is 10 feet, and its breadth is 2 inches; find the depth, the breaking load on the centre of a beam 1 foot long, 1 inch broad, and 1 inch deep, and supported at the ends in a horizontal position, being 450 lbs.

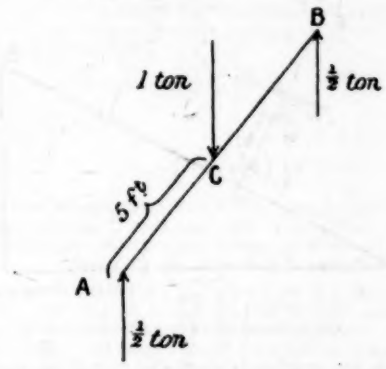
Two wooden beams are each loaded in the centre, and supported at the ends; one is solid and measures 8″ × 8″ in cross section; the other is made up of two beams, each 8″ broad and 4″ deep, and placed one over the other so as to have the same sectional area as before. Will there be any difference in the breaking load of the beams, and if so, how much will it be? State the reasoning on which you rely.

(*Applied Mechanics, Science and Art.*)

The maximum bending moment that a beam will bear without breaking is given by the formula

$$M = sbd^2.$$

Where M = maximum bending movement,
s = a constant depending upon the material,
b = breadth of beam,
d = depth of beam.



Let ACB represent the beam, then pressure on each support AB = $\frac{1}{2}$ ton.
Bending moment about C, the middle of the beam = $1120 \times 5 \times \frac{1}{2} = s \times \frac{1}{12} \times d^2$. (1)
For horizontal beam we have:—

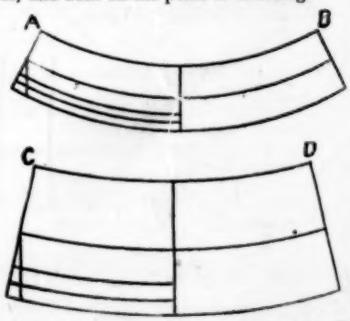
$$\frac{1}{4}\frac{1}{8}^0 \times \frac{1}{2} = s \times \frac{1}{12} \times \frac{1}{12^2}. \quad (2)$$

$$\text{Therefore } \frac{12^3d^2}{6} = \frac{1,120 \times 5 \times 2}{450}$$

$$\text{Whence } d^2 = \frac{\sqrt{7}}{9} \text{ feet.}$$

We may consider a beam as made up of a series of very thin slices taken parallel to the breadth. When the beam is bent the slices on the convex side will be extended, those on the concave side will be compressed; the two sets will therefore produce a couple whose moment is equal to bending moment. The outer slice will be most extended and will break first. Two beams of different depths will have the extension of the outer slice equal when they are on the point of breaking, the extension of the other slices being proportional to their distance from the neutral line.

Consider two beams, AB and CD, one of double the depth of the other, and both on the point of breaking.



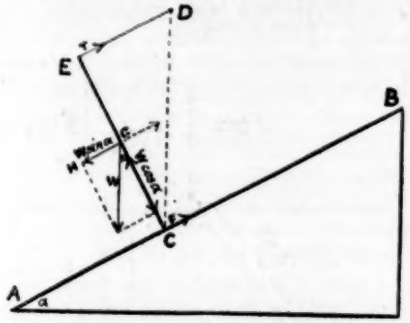
Divide AB and CD into slices, taking each slice of CD double the thickness of AB. The extension of corresponding slices in each will be the same, but the slice in CD, being of double the area and being at double the distance from the neutral line, will have four times the moment of the slice in AB, and so on for all slices in AB and CD. The breaking moment for CD will be four times that of AB, and therefore when both are loaded similarly, the same will hold for the breaking load.

From this it is manifest that two beams, each 4″ in depth, would require twice the breaking load of one, and the two together would require half the breaking load of a single and similar beam 8″ in depth.

Mechanics.

1. SCIENCE.—AB is a given inclined plane, C a point in AB, and D a point vertically over C; draw CE at right angles to AB, and ED parallel to AB. Suppose that CE represents a uniform rod standing on the inclined plane, and ED a thread by which the end E is fastened to a *fixed* point at D; if the rod is in equilibrium find the friction at C and the tension of the thread.

(*Honours Exam., Theoretical Mechanics, 1890.*)

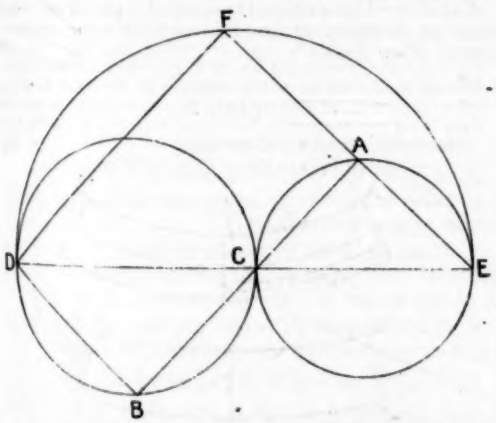


The tension T in the thread acts along ED and the friction F up the plane. Let W be the weight of the rod; then, this acts vertically downwards from its centre G. Resolve it into two components at right angles, W cos α along GC, which must be balanced by the equal and opposite reaction of the plane, and W sin α along GH.

Now the parallel forces W, F, and T together produce equilibrium. Hence, the resultant of F and T must act at G, and be equal and opposite to W sin α. But the resultant of the two parallel forces F and T is equal to their sum F + T. But G is the centre of the rod EC. Therefore F = T = ½ W sin α.

Geometry.

1. CYCLOPS.—Two circles touch each other externally at C; show how to draw a straight line through C to meet the circumferences at A and B respectively, so that AB may be equal to a given straight line, less than the sum of the diameters of the circles. (*Science and Art, 1885.*)



Draw the straight line DCE passing through the centres of the two circles. (III. 12.)

Upon DE describe a semicircle; and from D with the distance equal to the given straight line cut the semicircle in F.

Join F E, cutting circumference of circle CE in A.

Join AC, and produce it to meet circumference of circle CD in B.

Then AB shall be equal to the given straight line.

Join FD, FB.

Proof.—∠s CAE, DFE are right angles, (III. 31.)

∴ AB, FD are parallel; (I. 28.)

Also ∠ CBD is a right angle,

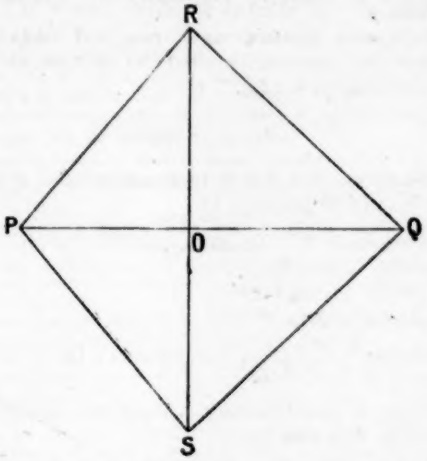
∴ BD, EF are parallel; (I. 27.)

Wherefore ABDF is a parallelogram,

∴ AB = DF (I. 34.) = Given straight line.

Q. E. F.

2. T. S.—If a triangle PQR be turned over about its side PQ, show by Prop. 4, Bk. I., that the line joining the two positions of R is perpendicular to PQ.



Let the triangle PQR be turned over about the side PQ into the position PQS.

Join RS.

Then RS shall be perpendicular to PQ.

Proof.—Let RS cut PQ in O.

In △s PRQ, PSQ,

side PR = side PS,

side RS is common,

and base QR = base QS,

∴ ∠ RPQ = ∠ SPQ. (I. 8.)

Again in △s PRO, PSO,

sides RP, PO = sides SP, PO,

and ∠ RPO = ∠ SPO,

∴ base RO = base SO,

and ∠ POR = ∠ POS; (I. 4.)

but these are adjacent angles,

∴ PO is at right angles to RS, (Def. 10.)

Wherefore RS is perpendicular to PQ.

Q. E. D.

How my School was Examined.

BY THE HEAD MISTRESS OF A SUBURBAN BOARD SCHOOL.

STANDARD I.

Arithmetic.—Three sums dictated.

1. Take 374 from 623.
2. From 900 take 87.
3. Add 505 + 86 + 694 + 789 + 999.

Answers—(1) 249; (2) 813; (3) 3073.

Writing.—A passage was transcribed from the reading books, and the following words were dictated:—

Great, Very, Much, Lately, Swans, Bridges, Build, High, Roof, Eight.

English.—The poem prepared for repetition was *Seven times one are seven*, by Miss Jean Ingelow. The children recited this and answered questions on the meaning.

Singing.—The following school songs were prepared:—1. *The Crystal Spring.* 2. *Hark, I hear the Sweet Bells ringing.* 3. *The Cuckoo.* 4. *How Sweet it is to Play!* 5. *Waiting for May.*

After giving ordinary time tests and modulator exercises, the examiner required the children to sing the third song on the list.

STANDARD II.

Arithmetic.—The following is one of the sets of sums dictated to Standard II.

1. Add 34 + 600 + 2,020 + 6,900 + 4,070.
2. From 12,000 take 958.
3. Divide 53,649 by 11.
4. Multiply 8,974 by 169.

Answers.—(1) 13,624; (2) 11,042; (3) 4,877 + 2 over; (4) 1,516,606.

Writing.—The following passage was written on paper from dictation:—

'It was very pleasant sitting upon the deck, watching the ships that passed them, and admiring the beautiful woods and rocks that lined the banks of the river. At last they sailed under a very lofty bridge, and here they were at Bristol. After much noise and shouting they were safely moored.'

English.—The poetry prepared for recitation was *A Night with a Wolf*, by Bayard Taylor.

The children were required to answer questions on the meaning; and also to select nouns and verbs from sentences in the reading lessons.

STANDARD III.

Arithmetic.—Typical Cards.

A. 1. Divide 74,126 by 139.

2. From £649 15s. 2¾d. take £42 4s. 9d.

3. Add together £73,148 6s. 7½d., £158 12s. 9d., £2 7s. 6d., £83 19s. 6¼d., and £37,600 2s. 3¾d.

4. I bought 8 eggs and 4 lbs. of butter with seven shillings. The butter cost 1/6 per lb. How much each did the eggs cost?

B. 1. £3,299 14s. 6½d. + £4,118,972 19s. 7d. + £1,020 0s. 3¾d. + £1 2s. 9d. + £36,892.

2. Subtract £1,943 9s. 4¼d. from £96,302 3s. 2½d.

3. Divide 369,436 by 790.

4. Two girls had 12/6 each. One spent 11/4 and the other spent 12/2. How much did they both have left?

Answers: *A.* (1) 533 + 39 over. (2) £607 10s. 5¾d. (3) £110,993 8s. 8½d. (4) 1½d. each.

B. (1) £4,160,185 17s. 2¼d. (2) £94,358 13s. 10¼d. (3) 467 + 506 over. (4) 1/6.

Writing.—The following paragraph was dictated from the reading book.

'Robin would sometimes go in disguise to a neighbouring fair at which a shooting match was sure to be held. In those days there was no guns, but bows and arrows were used instead. Once he was nearly taken prisoner by the Sheriff of Nottingham. Robin had gone there to shoot for a prize.'

English.—The children of this Standard had prepared for recitation the poem, '*Which shall it be?*' Easy questions were asked on the meaning of the lines.

Singing.—The following songs were prepared by Standards II. and III. as one group:—

1. *The Canadian Boat Song.* 2. *The Wild Rose.* 3. *The Harp that once thro' Tara's Halls.* 4. *The Vesper Song.* 5. *Softly Falling.*

After the usual exercises in time and tune the children were required to sing the last-mentioned song

STANDARD IV.

Arithmetic.—Specimen card.

1. A mile of land costs £8 8s. How much would 88 miles cost?

2. Divide £60,045 13s. 1d. by 89.

3. If a piece of gold weighed one ounce, how many such pieces could be made out of half a ton of gold?

4. Multiply £39 12s. 7½d. by 79.

Answers:—(1) £739 4s.; (2) £674 13s. 4¾d. + 41; (3) 17,920; (4) £3,130 17s. 4½d.

Writing.—The following passage was dictated from the reading book:—

'At the end of April, 1872, there was a fearful eruption. It had been expected for some time, for pillars of fire had been seen rising from the cone, loud explosions had been heard, and shocks of earthquake felt. At length a broad stream of lava was seen descending from the crater. Everyone was in terror, and fled to Naples or elsewhere. All night and all day they hurried away, carrying their little children, and helping on the poor old people.'

English.—The poetry prepared for repetition was the scene between *Hubert* and *Arthur* from Shakespeare's *King John.*

STANDARD V.

Arithmetic.—Specimen cards.

A. 1. Find the value of $\frac{2}{3} + \frac{5}{7} - \frac{1}{8}$.

2. What is the cost of laying 152 miles of telegraph wire at 5½ guineas per mile?

3. Make a bill for 12 books at 2s. 11d. each, 12 quires of note paper at 4d. per quire, 500 envelopes at 3d. per packet of 25, 7 frames at 1s. 4d. each.

4. If the keep of 34 horses amount to £58, what will it cost to keep 51 horses at the same rate?

B. 1. Find the cost of 256 articles at 10s. 2½d. each.

2. If 3 men can plough a field in 21 days, in what time will 5 men do it?

3. What is the difference between $(\frac{3}{5} + \frac{1}{3})$ and $(\frac{3}{5} - \frac{1}{3})$?

4. Make a bill for 19 lbs. of beef at 10½d. per lb., 13lbs. mutton at 9½d. per lb., 2 doz. kidneys at 3 for 1s., 12½ lbs. of lamb at 1s 1d. per lb, 9 lbs. of veal at 11½d. per lb.

Answers.—*A.* (1) $1\frac{43}{168}$. (2) £877 16s. (3) £1 15s. + 4s. + 5s. + 9/4 = £2 13s. 4d. (4) £87.

B. (1) £130 13s. 4d. (2) 12⅗ days. (3) $\frac{1}{12}$. (4) 16/7½ + 10/3½ + 8/- + 13/6½ + 8/7½ = £3 17s. 1d.

Writing.—Two stories were read for children seated alternately to reproduce. One of these was the following:—

Generally, when a vessel of war enters a harbour, a salute of one or more guns is fired. A man-of-war ship had once been on a long voyage, during which she had touched at several places, and at each of them, on anchoring, a gun had been fired off. No ship is allowed to fire guns when lying at the port of London, lest the firing should break the windows of the houses in the city, or startle the horses in the streets. A monkey that was on board the vessel wondered why a salute was not fired on dropping the anchor in the Thames, and made up his mind to repair the omission by firing the gun himself. Accordingly, when the attention of the crew was taken up by getting the vessel moored in the river, the monkey went to the cooking-stove, and with the tongs took out a piece of burning coal. He then ran off with it and placed it on the touch-hole of one of the guns, which happened to be loaded. Immediately the gun went off, and the whole neighbourhood was startled by the loud report of the cannon. The captain was tried for breaking the rules of the harbour, but was acquitted on proving that the cannon had been fired by the monkey.—*Chambers' Short Stories.*

English.—The passage for recitation was selected from the *Trial Scene* in the *Merchant of Venice.* Questions were asked on the meaning of the words and their grammatical connection. A sentence was also given for parsing and analysis.

STANDARD VI.

Arithmetic.—Specimen Card.

1. If 1 lb. of coffee cost 1/5, what will be the cost of 16 lbs. 12 ozs.?

2. Bring $\frac{22}{7}$ of 5 yds. 1 ft. to the decimal of 1 mile.

3. If 21 dollars represent £6 7s. 6d., what would 326 represent?

4. In what time will £525 amount to £700 at 3½ per cent.?

Answers: (1) £1 3s. 8¾d.; (2) $\cdot\dot{0}09523\dot{8}$; (3) £98 19s. $3\frac{3}{7}$d.; (4) $9\frac{1}{11}$ years.

Writing.—The following subjects for short essays were given to different children in Standard: *Snakes, The Sea, Cats and their ways, Ships, The Streets of London.*

STANDARD VII.

Arithmetic.—Specimen card.

1. A grocer mixes 27 lbs. of tea at 2s. 6d. per lb. with 30 lbs. at 1s. 11d. At what price must he sell the mixture so as to gain $3\frac{1}{4}$ per cent.?

2. What sum when reduced 17 per cent. will become 1660?

3. Five men after working 8 hours are joined by three others, and all work together for 16 hours. If the wages are £5 12s. 8d., what part should the first five receive?

4. In a school with 360 on the books, the number present on three half days in a week is 310, on two half days 308, on four half days 312, and on one half day 296. What is the average attendance for the week?

Answers: (1) 2s. $3\frac{13}{76}$d.; (2) £2,000; (3) $\frac{5}{7}$, that is $\frac{1}{7}$ each, or 16s. $1\frac{1}{7}$d.; (4) 309.

Writing.—The subjects given for Composition were:—(*a*) *Railways*—(*b*) *Different Ways of Lighting*—(*c*) *The Sky and its Wonders*—(*d*) *Writing and its Uses.*

English.—The recitation prepared by the Sixth and Seventh Standards was selected from *As You Like it.*

Singing.—For this subject Standards IV. to VII. formed one group, and prepared the following part songs:—(1) *Roaming in May;* (2) *Parting Day;* (3) *The Wanderer's Morning Greeting;* (4) *Summer,* and (5) *Isle of Beauty.* The last was the piece selected by the Inspector.

Publications Received.

BACON, G. W., & Co.—The Excelsior Map of England and Wales.

BEMROSE & SONS.—A Continental Scamper: being Reminiscences of a visit to the Passion Play of Ober-Ammergau.

BLACKIE & SON.—Vere Foster's Drawing Books: Perspective and Model Drawing; Modern Cyclopædia, Vol. 6 (*Dr. Annandale*).

CAMBRIDGE UNIVERSITY PRESS.—Lectures on Language and Linguistic Method in the School (*Laurie*).

CLIVE, W. B., & Co.—Livy: Book I., with Text, Notes and Vocabulary (*Allcroft and Mason*).

COMBRIDGE & Co.—Models for Latin Prose Composition (*J. Oliver*).

CURWEN & SONS.—School Songs: The Jolly Jack Tar; Village Minstrels are We (*Foxwell* and *Hutchins Lewis*); Choruses for Equal Voices; Cantata: Queen Revel.

DAWSON, A. G.—The Townley Algebraical Tests: Parts I. and II. (*Ellery*); The Townley Standard Geography: Standard IV.; The Townley Freehand Test Cards: Set A.

LAURIE, T.—Shorthand for Everybody (*W. Mattieu Williams*); The Philosophy of Clothing (*W. Mattieu Williams*).

LONGMANS & Co.—Arithmetic: Book 7.

MACMILLAN & Co.—Literature Primers: Questions and Exercises on English Composition (*Prof. Nichol* and *McCormick*); Elementary Algebra (*C. Smith*); Progressive French Course, Second Year (*Eugène-Fasnacht*).

MISCELLANEOUS.—Answers to Bible Questions for Mr. Cuthbert's Sabbath Class (*R. Maclehose*); Lippincott's Monthly Magazine: June (*Ward, Lock & Co.*).

NELSON, THOS., & SONS.—The Royal Story-Book Readers: Standard I., Stories and Fables; Standard II., Children's Pets; Standard III., The Hans-Andersen Story Book; Standard IV., The Swiss Family Robinson.

PHILIP, G., & SONS.—Recitations, Rhymes, and Dialogues for Kindergarten Schools (*Emily Warnington*); Standard Atlas, Nos. 1, 2, 3, and 4; Guide to Composition.

PITMAN, J., & SONS.—A Complete Guide to the Improvement of the Memory (*Rev. J. H. Bacon*).

SMITH, ELDER & Co.—Vanity Fair (*Thackeray*)—Waterloo Edition; The Cornhill Magazine: July.

WILLIAMS & NORGATE.—German Reader and Grammar for Beginners (*Hickie*).

How to Teach School Children to Sing from the Staff Notation.

BY W. G. McNAUGHT,

Associate of The Royal Academy of Music.

THE TEACHING OF TIME.

DIVISION II.—CODE REQUIREMENT.—(ENGLISH.)

To sing on one sound to the syllable 'laa' an exercise in ¾ or ⅔ time, which shall include minims and crotchets. (The Scotch Department does not ask for ⅔ time in this division.)

35. In teaching time the first things to do are to awaken the sense of rhythm and to get pupils to observe and differentiate with their own ears the main facts of time. The connection of notation with practical skill will then be found easy to make. The fact that the arithmetical relations shown by the chief notes used in the staff notation of time are so easily understood by the mind sometimes deludes teachers into supposing that they have successfully taught time itself when they have got

pupils to answer questions on the relations of crotchets, quavers, and minims. But time must be felt, not merely understood. It would be easy to invent signs that would clearly stand for three-fourteenths, three-sevenths, and five-fourteenths of a beat, but not the most experienced performer could conceive the rhythmic effect from the symbols. Teachers are therefore recommended not to teach the whole 'time table' from demisemiquaver to breve, but to be content with a few principal notes the relations of which can be easily felt.

36. The important facts of rhythm are—

1st The pulse or beat.
2nd The regular recurrence of pulses.
3rd The varied accent of pulses resulting in the formation of bars or measures.
4th The rate of the recurrence of pulses.
5th The division of pulses.

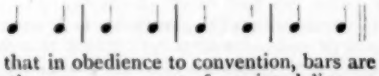
37. The first and second facts can be practically felt by the children by getting them to clap or march to a bright tune sung or played by the teacher. In doing this they will instinctively register the 'pulse' of the tune. This exercise should be repeated at intervals until the class is thoroughly permeated with the idea of the pulse. Accent should be taught experimentally. Thus the teacher may strike the board with the pointer three or four times, at first taking care to strike with equal force throughout and afterwards very apparently making one strong in every two, three, or four strokes—and get the class to describe what they hear. When the idea of varied accent is thus completely felt, the next step should be to associate the pulse with the beating of the baton or pointer. Then the class should be taught to distinguish between tones held for one beat and tones held for two or more beats. Notation can now be safely taught.

38. The first exercises should, as a rule, be sung on a monotone, so as to concentrate the attention on the rhythmic effect. It is a pleasant form of ear exercise to give both tune and time together, as when a teacher asks the class to say which scale notes he holds for two pulses in the phrase he sings to sol-fa syllables. The fitting of time and tune together calls for special practice.

39. It is unfortunate that there is no general agreement amongst musicians as to the pulse-symbol. Minims, crotchets, or quavers, are in turn the pulse-standard. The Scotch Code asks for 'crotchet' time only, but the English Code asks for 'minim' time as well. As the crotchet is the most frequently employed pulse-standard it is unquestionably best to adopt it for this purpose in the earlier lessons. A simple explanation that a 'head' with a 'stem' turned up or down is called a crotchet, and is to stand for a pulse is all that is necessary. It is as well to introduce the minim at almost the same time because signs are best taught by contrasting one with the other. The exercises need not be written on lines and spaces. Time signatures are not yet necessary. The bar should be explained as a sign showing where the accent falls. In fixing this notational point in the minds of pupils the teacher should interest the class by inviting pupils to come forward and draw bar lines to correspond with the accent he makes in an unbarred exercise.

Example unbarred.

The same barred in twos.



The fact that in obedience to convention, bars are never placed at the commencement of a printed line need not be observed just now.

40. The time names used in the Cheve method and the tonic sol-fa method will be found very useful in strengthening the connection between sign and effect. They are really easier to say than 'laa' and are certainly more agreeable in effect than the old plan of saying 'crotch crotch, quaver quaver,' etc., to a series of notes. The principle of their construction is to provide a syllable consisting of a consonant and vowel for every struck note and a simple vowel for continuations. A one-pulse note is called—

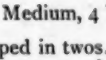
TAA

and a two-pulse note—

TAA — AA

The time names should be always sung in time. They should be used as a means to an end. Exercises should be sung to names and then to 'laa.'

41. The inclusion of four-pulse measure in the requirements would seem to call for specific teaching of the medium accent that generally falls upon the third pulse; the theoretical order of accents in a four-pulse bar being as follows—

1 Strong, 2 Weak, 3 Medium, 4 Weak. 

the accents being grouped in twos. But not very much need be said on this matter. As a rule the medium accent takes care of itself if the strong accent is duly attended to. It is generally sufficient to stop pupils from making two equally strong accents.

42. The following exercises illustrate the requirements of the code in crotchet time. Some are in $\frac{2}{4}$ time because this time must naturally form one of the steps in teaching.

The time signatures are inserted for the guidance of the teacher but they should not be written in until they are explained.

Specimen Code Tests in $\frac{4}{4}$ and $\frac{2}{4}$ Time.

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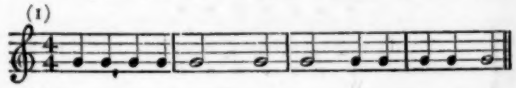

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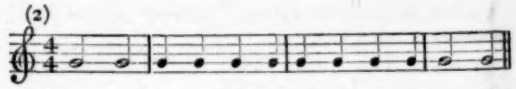
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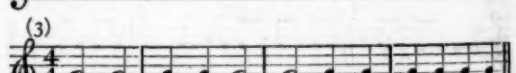

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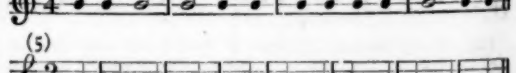

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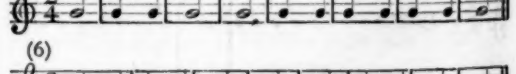
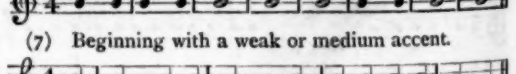


(7) Beginning with a weak or medium accent.



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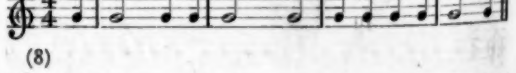

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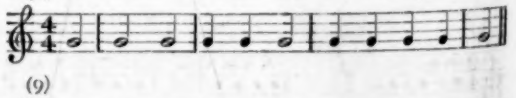

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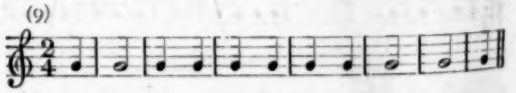


43. The inclusion of minim time in the English requirements, and the stipulation that crotchets are to be used, involves the study of half-pulse notes or two equal notes to one beat. There is then a rhythmic fact to be taught—an idea to be assimilated—and a notational connection to be established. The following form of lesson serves for an introductory

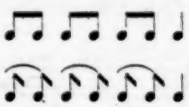
Lesson in Half-Pulses.

Teacher beats four pulses singing one tone in each beat. He then asks pulpils to discover in which of the four beats he sings two notes. Teacher sings, dividing third beat. This is imitated by the class. Teacher sings again, dividing another beat. The class imitates. The time name TAA-TAI is then given and the class exercised by the teacher pointing on the board to the names—

TAA or LAA
TAA-TAI LAA-LAA.

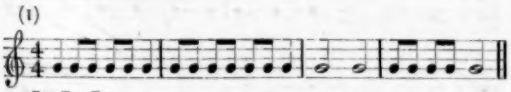
and more ear exercises follow. If the names are not to be used the syllables laa and laa-laa can be written on the board.

44. The first notational association of half-pulse notes should be established in 'crotchet' time because of its frequent use and because it is obviously better to introduce a new sign in connection with a new thing. The quaver must, therefore, be explained. The speciality of its hook when written singly and the speciality of the connecting band when written in pairs should be duly emphasised. The quavers grouped in pairs are most easily understood. When presented singly it is well at first to put a curve or brace over the two that belong to one pulse—



The following exercises mix quavers, crotchets, and minims in crotchet time—

(1)



TAA TAA-TAI

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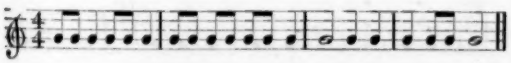

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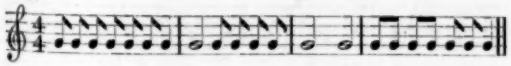

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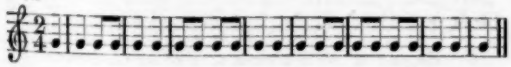

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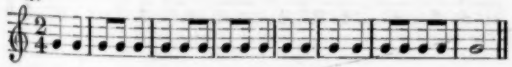

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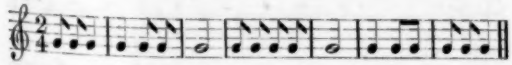

(To be continued.)

Practical Needlework in Elementary Schools, by Miss J. W. Warren; Studies in English Literature, by C. J. Dawson, B.A.; and Model Answers to Certificate Questions, will appear in our next issue.

Publications Reviewed.

Royal English Class Books: Lower Grade English. London: T. Nelson and Sons.

This is a small text-book, which aims at giving in a compact form all the work in English required in the Junior Division of the Local University Examinations, the Leaving Certificate Examination of the Scotch Education Department, and other similar examinations. It contains outlines of grammar and analysis of sentences, hints on sentence-making, punctuation, paraphrasing, sections on derivation and distinction of words, and tables of English literature. The matter is well-arranged, and will no doubt go far to fulfil the intentions of the compiler; but we can hardly think it wise for candidates for such examinations as those named to depend entirely on a single text-book of this condensed kind. No exercises are given. These, it is suggested, can be obtained from the ordinary reading books.

Graduated Stories for Composition. Written and compiled by T. B. Ellery, F.R.G.S. London: Gotch and Gomme.

This is a very good collection of short stories for practice in composition. The preface contains some admirable hints simply stated and practical in character. A tolerably successful attempt is made to graduate the stories, the difficulty which attaches to the use of direct quotation being deferred to the second part of the book, and the exercises in each part increasing in length and complexity towards the end. We notice, however, that although the employment of participles is specially referred to in the preface as needing care, they occur with needless frequency in some of the earlier stories. Some of the anecdotes are drawn from such standard books as *The Natural History of Selborne*, and the authority is given in several other cases. We believe many teachers would feel greater satisfaction, and scholars would derive some benefit, if the plan of quoting authorities for stories given as materials for composition exercises were more frequently followed.

The book is well printed, but as it is of a kind likely to be in constant use for a long time it is a pity the covers are not at least of limp cloth rather than paper.

Shorthand for Everybody. By W. Mattieu Williams. London: Thomas Laurie.

Among the many new or revised systems of shorthand that have appeared of late we think this is deserving of consideration.

In a handbook consisting of some fifty well printed pages we have clearly sketched out in a course of lessons for self-instruction an intelligible system of shorthand which may be written on the basis of either the phonetic or ordinary alphabet. One important feature of Mr. Williams' system is that all vowels can be joined to consonants.

The whole thing is simple and can be easily acquired. The student who learns the alphabet, a few contractions, and the method of joining the vowels, should, we think, by careful attention to the instructions and exercises, rapidly master the system and write with some facility.

The author has had much experience, having studied for many years most of the systems which have from time to time appeared. He does not pretend that his treatise will satisfy the requirements of reporting, *i.e.*, verbatim reporting. It is a system of *short hand* pure and simple, to enable any person to write something like four times as fast as he could if the ordinary common longhand characters were employed.

We have much pleasure in calling the attention of our readers to this little work.

Herodotus. Book VI. Edited by W. F. Masom, B.A., and C. S. Fearenside, B.A. University Corr. Coll. Series. London and Cambridge: W. B. Clive and Co.

This edition is arranged on the same plan as the other classical books published in this series, with the purpose of meeting the wants of students preparing for the London University examinations, and especially those who have not the advantage of *vivâ voce* teaching in their work. For their use are provided, in addition to text and notes, a translation, a vocabulary, a very needful excursus on the peculiarities of the new Ionic dialect, a historical introduction, and a number of test questions. The editors have done their work with creditable care and accuracy. The translation in most cases serves its end of guiding the learner to the right construction of the Greek, and it would therefore perhaps be hardly fair to criticise its deficiencies in point of literary style. Still, it must be admitted that the learner will seldom go beyond the teacher, and that he will inevitably take the rendering which his book supplies as a model for his own translation, whether it is the editor's intention or not that it be so used. The dilemma is no doubt difficult to escape; but we think that the claims of style in translations of the present kind are generally too entirely disregarded. The notes are mostly brief, and concisely expressed: here and there, perhaps, a case might be made out for extension or addition.

In chapter 12 the notes and translation are at variance on the sense of ὅκως, the former taking it as a final, the other as a temporal, particle. In ch. 29, both note and translation take φιλοψυχίην τοιήνδε τινα ἀναιρέεται ὡς as meaning 'he conceived *so great* a love of life, *that, etc.*,' which is at least misleading. It should be 'He displayed his love of life in *the following way; when, etc.* Ερῆμον ἀνδρῶν, in ch. 23, means 'without *men* to defend 'it,' not 'destitute of inhabitants.' In ch. 42 it is better to take τούτων as genitive of comparison with πλέον, than with οὐδέν. The first paragraph of ch. 13 is much in need of some further explanation than is given by mere translation; the construction of the sentence is sure to be a puzzle to the beginner. There is a somewhat similar difficulty and want of assistance in ch. 53, where the construction of καταλεγομένους should have been explained in a note. In the case of λάμψαντας, in ch. 82, the omission is still more serious. As the text stands, number, gender and case of the participle are all difficulties, if not impossibilities; and the correction to λάμψαντος is so easy as to be irresistible.

History of France; History of Scotland. Adapted for Youth, Schools and Families by Miss Corner. London: Dean and Son.

These books have already enjoyed a large circulation, having passed through many editions. They therefore need little introduction. In the present revised editions supplementary chapters have been inserted in order to bring the works up to date. Miss Corner's style is pleasing and should awaken an interest in the reading of history. The printing and illustrations are very second rate. The volumes are, however, well bound and cheap.

Vere Foster's Drawing Book. New Edition. U and V. London: Blackie & Son.

These are very useful numbers. They are intended to give a rudimentary knowledge of perspective and of model drawing. The four numbers for perspective are supposed to be studied and mastered before proceeding to the four numbers in Model. We think figures one, two, and three, which show the position of the various planes, lines and points in the first number on perspective, should have been drawn in perspective. With this exception, the books are everything that a practical teacher could want; and those who have not yet taught drawing and yet now must, could not do better than get the books and work through them before attempting a larger and more complete work. For sixteenpence any teacher could thus acquire sufficient knowledge to enable him to give easy lessons in model drawing with advantage.

Several Reviews are unavoidably crowded out and will appear in our next issue.

CORRESPONDENCE.

SIR,—May I ask a small portion of your valuable space, in order to correct a serious misconception on the part of the writer, who, in your last issue, reviewed the 'Periodical Examination Report Form' compiled by myself and published by Mr. A. G. Dawson.

Your reviewer states that in the sheet under reference 'the teachers are judged and placed in order, according to percentages of passes.' This is an entirely erroneous statement; no reference being made to percentages in the list showing the position taken by the various classes in the Head Teacher's examination, as will be seen from the sheet now enclosed. Percentages of Passes are necessarily shown in the results under the 3 R's, but they occupy, as you will see, by no means an important feature of the form.

Your reviewer further states that 'a teacher may be hurt in feelings,' presumably by reason of the appearance of a criticism of his work upon the sheet. A mere glance at the form will inform you that such criticism is reserved for the 'Teacher's Syllabus Book'—a private note book with which each teacher is supplied—the sheet showing only the 'Praiseworthy Points' in each teacher's work.

Assured that you will give the same publicity to this statement as to that of your reviewer.

I am, SIR,
Your obedient Servant,
THOMAS J. MACNAMARA.

62, Richmond Road,
Montpelier, Bristol,
June 5th, 1890.

SIR,—Mr. Macnamara's ideas of importance are—to say the least—peculiar. I have always been accustomed to consider that the use of red ink was to give prominence to the matter it was used to pourtray. In the form under notice the only red ink lines are those in which 'percentage of passes' is enclosed, and a special direction says, 'Enter all percentages in red ink.' Nothing could be more prominent than percentages where we have '% of passes' for Reading, Writing and Arithmetic separately, in addition to '% of sums correct' and 'Total % of 3 R's.'

I maintain that it is no one's business but the class teacher's and the head teacher's to know anything about percentages, and that there is no necessity whatever for a calculation to be made for affixing to the notice board in the schoolroom. I accept Mr. Macnamara's disclaimer that he did not intend to assess the position of the standard or the teacher by percentages alone. At the same time, I submitted the sheet to teachers of great repute asking their opinion as to the meaning of 'Position—This Exam., Last Exam.' on the form, and in every case I got the answer, 'Why, percentage position, of course.'

To place a record for inspection by scholars and others in a prominent part of the schoolroom, in which teachers are pitted against each other because of the position they may take in an examination in which the conditions are so entirely dissimilar as in Standards I. to VII. is to provoke undue rivalry, jealousy and uncharitableness. It is not calculated to enhance the good feeling which ought to exist between heads and assistants, and to a sensitive assistant is calculated to work great injury to feelings and reputation. At the same time it is a misleading statement to call the form a 'Report Form' if it contains only a partial report, even though the points recorded are favourable ones.

Mr. Macnamara's letter does not alter my opinion,—based upon an experience gained in school for many more years than Mr. Macnamara has had—that the use of the form in public is calculated to perpetuate a degrading method of calculating educational results and therefore ought not to be encouraged.

I am,
Yours, &c.,
THE REVIEWER.

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